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HEWLETT hp PACKARD

Model 4944A
Transmission Impairment Measuring Set

Operating Instructions

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OPERATING INSTRUCTIONS

TRANSMISSION IMPAIRMENT MEASURING SET

Model 4944A
All Serial Numbers

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690 E. Middlefield Road, Mountain View, CA. 94042 U.S.A.

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CONTENTS

GENERAL INFORMATION

SECTION		PAGE
I	INTRODUCTION	1
II	DESCRIPTION OF CONTROLS, CONNECTORS, AND INDICATORS	3
III	SETUP AND TURN ON PROCEDURE	7
IV	SELF-CHECK PROCEDURE	9
V	CONDITION CODES	12
VI	DIAL, TALK, LISTEN, AND HOLD PROCEDURES	15

NORMAL OPERATION PROCEDURES

VII	NORMAL LEVEL AND FREQUENCY PROCEDURES	
	NORMAL TRANSMITTER	19
	NORMAL RECEIVER	21
VIII	NORMAL MESSAGE CIRCUIT NOISE PROCEDURES	
	NORMAL TRANSMITTER	23
	NORMAL RECEIVER	25
IX	NORMAL NOISE-WITH-TONE PROCEDURES	
	NORMAL TRANSMITTER	27
	NORMAL RECEIVER	29
X	NORMAL SIGNAL-TO-NOISE PROCEDURES	
	NORMAL TRANSMITTER	31
	NORMAL RECEIVER	33
XI	NORMAL IMPULSE NOISE PROCEDURES	
	NORMAL TRANSMITTER	35
	NORMAL RECEIVER	37
XII	NORMAL ENVELOPE DELAY-RETURN REFERENCE PROCEDURES	
	NORMAL TEST SET	39
	REPEAT TEST SET	41
XIII	NORMAL ENVELOPE DELAY-FORWARD REFERENCE PROCEDURES	
	NORMAL TEST SET	43
	REPEAT TEST SET	45
XIV	NORMAL NONLINEAR DISTORTION PROCEDURES	
	NORMAL TRANSMITTER	47
	NORMAL RECEIVER	49

MASTER/SLAVE OPERATION PROCEDURES

XV	SLAVE SETUP PROCEDURE	53
XVI	MASTER LEVEL AND FREQUENCY PROCEDURE	55
XVII	MASTER MESSAGE CIRCUIT NOISE PROCEDURE	57
XVIII	MASTER NOISE-WITH-TONE PROCEDURE	59
XIX	MASTER SIGNAL-TO-NOISE PROCEDURE	61
XX	MASTER IMPULSE NOISE PROCEDURE	63
XXI	MASTER ENVELOPE DELAY PROCEDURE	67
XXII	MASTER NONLINEAR DISTORTION PROCEDURE	69

INTRODUCTION

This booklet contains quick reference instructions for operating the Hewlett-Packard Model 4944A Transmission Impairment Measuring Set (TIMS). For more detailed operating instructions, description, and service information, refer to the Operating & Service Manual (HP Part No. 04944-90002).

Operating instructions are organized in three parts within this manual. General Information and Procedures are contained in sections on white pages; Instructions for NORMAL, or manual, operation are contained in sections on blue pages; Instructions for MASTER/SLAVE, or remote, operation are contained in sections on yellow pages.

The Model 4944A can also be operated under calculator or computer control and acquisition when equipped with Option 010 Hewlett-Packard Interface Bus (HP-IB). Instructions for programming and operating HP-IB are contained in the 4944A Operating & Service Manual.

GENERAL DESCRIPTION

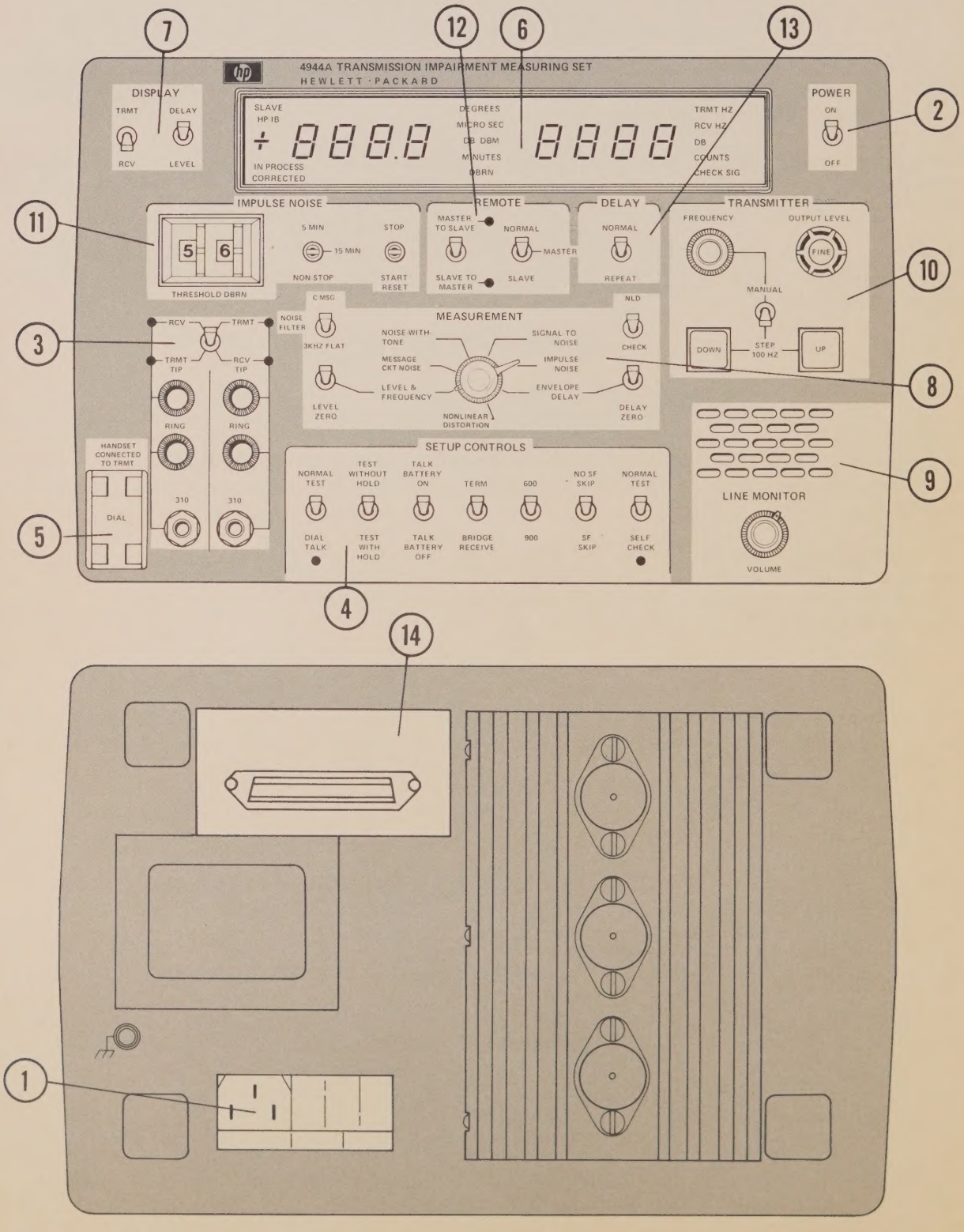
The 4944A measures all of the basic parameters necessary to characterize a voice channel for its ability to transmit data traffic, as defined by Bell System Technical Reference PUB 41009, dated May 1975. Measurements can be made manually end-to-end with a 4944A at each end of the circuit; manually looped-back with a 4944A at one end of the circuit; or remotely from one end with a MASTER operated 4944A controlling a SLAVE operated 4944A, with all measurements displayed on the MASTER unit. The 4944A can be operated with other test sets with compatible measurements and capabilities.

All measurements are displayed on digital readouts. Two separate readouts allow simultaneous display of up to two different parameters. The displays can be selected to show either transmitted or received information. Measurement unit annunciators beside each readout automatically show the operator the measurement displayed. Ranging, decimal placement, and polarity are all completely automatic.

IDENTIFICATION

Each unit is identified by a distinctive serial number and option number (if applicable) engraved on a plate on the rear of the test set. Please refer to this identification when corresponding with Hewlett-Packard regarding servicing and operating matters.

DESCRIPTION OF CONTROLS, CONNECTORS, AND INDICATORS



DESCRIPTION OF CONTROLS, CONNECTORS AND INDICATORS

(1) **Power Cord Module.** Accepts power cord supplied with instrument. Contains line fuse and PC board for selecting line voltage (see Section II of the 4944A Operating and Service Manual). WARNING: ALWAYS CONNECT POWER CORD TO A PROPERLY GROUNDED 3-WIRE POWER OUTLET.

(2) **POWER Switch.** Switches test set ac operating power ON and OFF.

(3) **RCV-TRMT Jacks.** A two position toggle switch is used to reverse connections of the left and right jack fields. When switch is in up position, the left jacks are connected for RCV (receive) and the right jacks for TRMT (transmit). When switch is down, connections are reversed. Dot lamps indicate functions of respective jack fields. Connections can be made either to the 310 jacks, or to the TIP and RING binding posts, which are multipled.

(4) **SETUP CONTROLS.**

NORMAL TEST – DIAL/TALK SWITCH. In NORMAL TEST position the selected TRMT jack is connected to the test set's transmitter circuitry, but not to the DIAL connectors. In DIAL/TALK position the TRMT jack is connected to the DIAL connectors, but not to the transmitter circuitry.

TEST WITHOUT HOLD – TEST WITH HOLD Switch. In TEST WITHOUT HOLD position the test set holding circuits are disconnected from the RCV-TRMT jacks. In TEST WITH HOLD position the holding circuits are connected across TIP and RING of both jack fields to hold 2-wire wet (DDD) circuits while testing.

TALK BATTERY ON – TALK BATTERY OFF Switch. In TALK BATTERY ON position the test set provides the necessary talk battery to the DIAL terminals to talk on dry circuits with a lineman's handset. In TALK BATTERY OFF position, talk battery must be supplied by the circuit under test if talking is desired.

TERM – BRIDGE RECEIVE Switch. In TERM position the test set provides a termination on both the RCV and TRMT circuits. The desired terminating impedance must be selected with the 600-900 switch. In BRIDGE-RECEIVE position the receiving test set is bridged across the circuit under test, which must be terminated with other equipment. NOTE: When using BRIDGE RECEIVE it is still necessary to select the proper impedance of the line under test with the 600-900 switch in order to normalize the measurements.

600-900 Switch. The 600Ω or 900Ω termination must be selected to match the characteristic impedance of the line under test. When operating in TERM mode, both the TRMT and RCV circuits are terminated in the selected impedance. When operating in BRIDGE RECEIVE mode, the TRMT circuit is still terminated in the selected impedance and the RCV circuit is bridged by more than 45 kΩ. The selection also normalizes level measurements for the respective impedances.

(continued on next page)

NO SF SKIP – SF SKIP Switch. In NO SF SKIP position the test set will transmit all selected frequencies. In SF SKIP position the test set will not transmit any frequencies between 2450 Hz and 2790 Hz. This feature prevents the circuit under test from being disconnected by SF signaling units on the dial-up network.

NORMAL TEST – SELF CHECK Switch. In NORMAL TEST position the test set performs normal testing. In SELF CHECK position proper operation of the test set can be verified by performing the procedures given in the SELF CHECK section of this manual.

(5) **DIAL Connectors.** Provides connections for a lineman's handset (butt-in). The terminals are connected to the selected TRMT jack when the DIAL/TALK mode is selected.

(6) **Digital Displays.** Two digital displays provide quantitative information and measurement units for all measurements. Ranging is automatic, and polarity and decimal points are automatically displayed when appropriate. Up to two parameters can be displayed simultaneously. The displays also indicate underrange and overrange conditions. Display of only a (–) sign indicates underrange. Display of only a (+) sign indicates overrange.

(7) **DISPLAY Switches.**

TRMT – RCV Switch. Selects either the transmitted or received information to be displayed.

LEVEL – DELAY Switch. Used in ENVELOPE DELAY measurements to display either level (DBM) or delay (MICRO SEC) information.

(8) **MEASUREMENT Switch.** Programs the test set to perform the selected measurement. For a detailed procedure describing the use of each MEASUREMENT switch position, see the appropriate section of this manual.

LEVEL ZERO Switch. Used in LEVEL & FREQUENCY mode to establish a zero dB reference. All subsequent measurements will be made in dB relative to this reference. If this switch is not operated, measurements will be in absolute dBm. NOTE: If LEVEL ZERO switch has been actuated and it is desired to make an absolute dBm measurement, momentarily rotate MEASUREMENT switch to another position, then back to LEVEL & FREQUENCY again.

DELAY ZERO Switch. Used in ENVELOPE DELAY mode to establish a zero microsecond delay reference. All subsequent envelope delay measurements will be relative to this reference.

NOISE FILTER Switch. Used in NOISE measurements to select desired weighting filter (C-MSG or 3KHZ FLAT).

NLD CHECK Switch. Used in NONLINEAR DISTORTION measurements to compare normal test signal with a check signal to allow compensation to be made for background noise. In CHECK position, amplitude of the 860 Hz tones is doubled and the 1380 Hz tones are turned off.

(9) **LINE MONITOR Speaker and VOLUME Control.** Permits listening to the circuit under test, or the test set transmitter. The DISPLAY TRMT – RCV switch determines whether the transmitted or received signal is being monitored. The speaker output is an amplified reproduction of signals on the circuit. Speaker output can be controlled with the VOLUME control.

(10) **TRANSMITTER Controls.**

MANUAL – STEP 100 HZ Switch. In MANUAL position frequency is continuously variable from 200 Hz to 3950 Hz by adjusting the FREQUENCY control. In STEP 100 HZ position frequency is manually stepped in 100 HZ increments from 204 Hz to 3904 Hz by depressing the UP and DOWN pushbuttons.

OUTPUT LEVEL Control. Varies transmitter output level continuously from –39 dBm to +10 dBm. Output level is displayed on left display.

(11) **IMPULSE NOISE Controls.**

THRESHOLD DBRN Switches. Sets the desired threshold above which impulse noise peaks will be totalized on the display. The threshold is adjustable from 30 to 109 dBrn.

5 MIN – 15 MIN – NONSTOP Count Time Switch. Selects length of time for which impulse noise is counted. Counting is stopped automatically when either the 5 MIN or 15 MIN positions are selected. Counting must be stopped manually with the STOP – START/RESET switch when the NONSTOP position is selected.

STOP – START/RESET Switch. Impulse noise counting is stopped and total is held on display when switch is momentarily held in STOP position. All previous counts are reset to zero on display and new counting interval is initiated when switch is momentarily held in START/RESET position.

(12) **REMOTE Switches.**

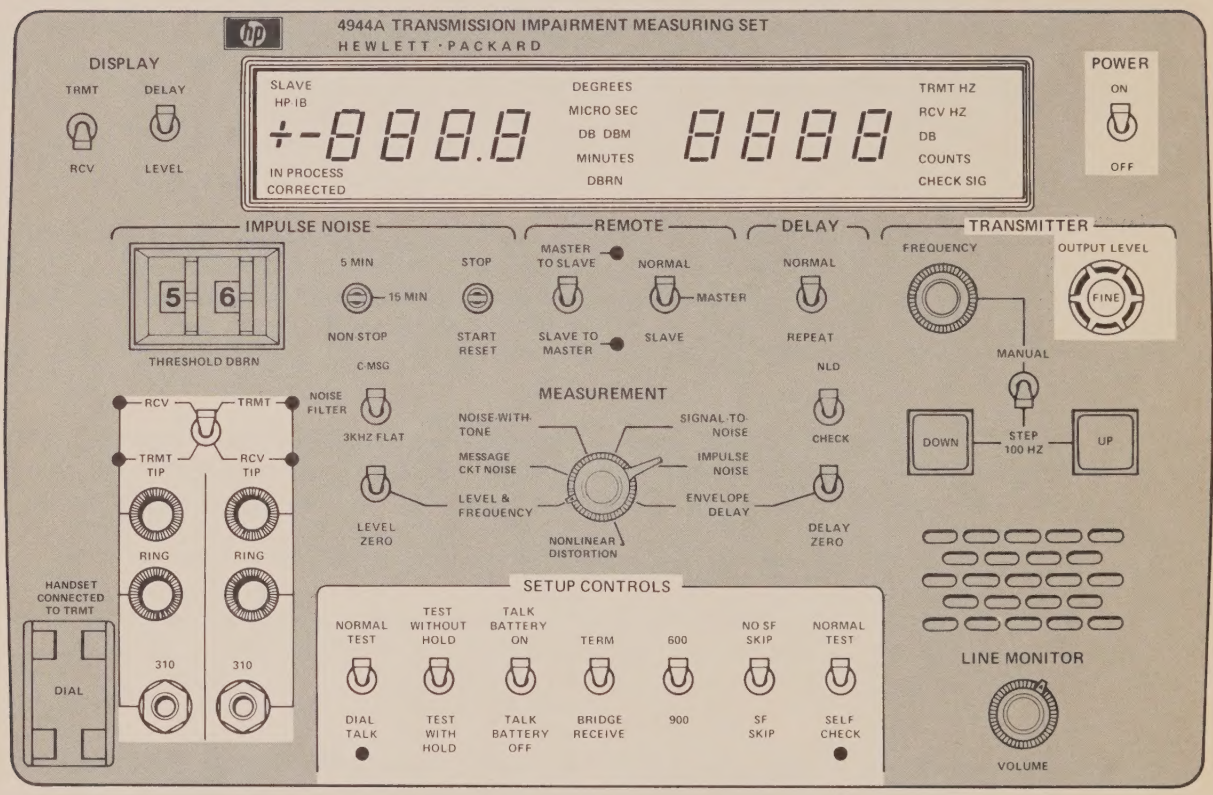
MASTER TO SLAVE – SLAVE TO MASTER Switch. Selects transmission path to be tested. Selecting the MASTER TO SLAVE position will cause the circuit connected to the TRMT jack at the MASTER unit to be tested. Selecting the SLAVE TO MASTER position will cause the circuit connected to the RCV jack at the MASTER unit to be tested. The dot lamp associated with the respective position indicates that the MASTER unit has achieved control of the SLAVE unit. The lamp should light within 10 seconds after the NORMAL – MASTER – SLAVE switches are properly positioned on both the MASTER and SLAVE units.

NORMAL – MASTER – SLAVE Switch. In NORMAL position all controls are under manual control. The test set can be operated manually with other compatible test sets. In MASTER position the unit is in remote control of the SLAVE unit for all MEASUREMENT functions. In SLAVE position the unit is remotely controlled by the MASTER unit for all MEASUREMENT functions.

(13) **DELAY Switch.** Used in ENVELOPE DELAY mode to determine whether the test set is to measure envelope delay (NORM), or to retransmit the envelope delay signal from the far-end of the circuit (REPEAT). This control is not used during MASTER-SLAVE operation.

(14) **HP-IB Connector (Optional).** Connections to Hewlett-Packard Interface Bus for controlling the Model 4944A with a calculator or computer. Refer to 4944A Operating and Service Manual for complete description and installation instructions for HP-IB.

SETUP AND TURN ON



SETUP AND TURN ON

1. Referring to Section II of the 4944A Operating and Service Manual, verify that instrument is set for line voltage to be used (100V, 120V, 220V or 240V) and that proper fuse is installed (0.75A normal blow for 100V and 120V; 0.375A normal blow for 220V and 240V).
2. Connect power cord to rear panel power receptacle and to a PROPERLY GROUNDED 3-WIRE POWER OUTLET.
3. Set POWER switch to ON to apply power to test set.
4. Set SETUP CONTROLS switch to BRIDGE RECEIVE if test set is to be bridged across receive line. Set to TERM if test set is to be used as termination on receive line.
5. Set SETUP CONTROLS switch to 600 or 900 to match impedance of lines under test.
6. Set SETUP CONTROLS switch to SF SKIP if transmitting over a dial-up network and single frequency (SF) signaling units are on the network.
7. Set SETUP CONTROLS switch to NORMAL TEST. Refer to SELF CHECK procedure if desired to verify test set performance.

NOTE

The SELF CHECK procedure should be performed periodically to verify performance of the test set. SELF CHECK is recommended before transporting the test set to a remote testing site, or whenever there is any doubt about transmission measurement results.

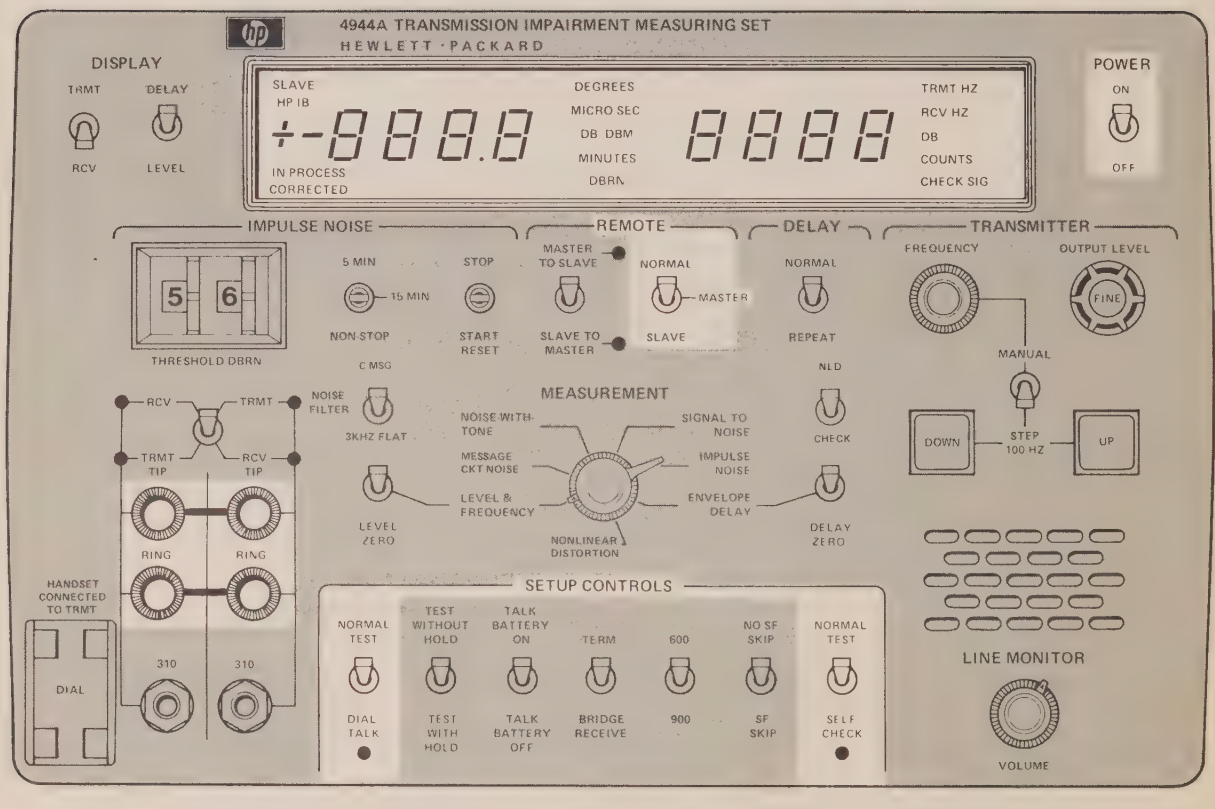
8. Set SETUP CONTROLS switch to TEST WITHOUT HOLD.
9. Turn OUTPUT LEVEL control full counterclockwise.
10. Position RCV-TRMT jacks switch to select the receive or transmit function for the left jack field. Connect transmit and receive lines (if both are required) to the appropriate jacks. Refer to DIAL, TALK, LISTEN, & HOLD procedures if dialing, talking, listening, or holding is desired on the lines under test.

NOTE

A 4-wire circuit is required to operate in the remote MASTER-SLAVE mode. If desired to test a 2-wire circuit in the remote MASTER-SLAVE mode, a second 2-wire circuit must be provided.

11. If remote MASTER-SLAVE operation is desired, refer to SLAVE SETUP or MASTER OPERATION procedures.
12. Select desired MEASUREMENT mode and refer to appropriate measurement procedure.

SELF-CHECK


4944A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT · PACKARD
DISPLAY
TRMT
DELAY
RCV
LEVEL
SLAVE
HP IB
IN PROCESS
CORRECTED
DEGREES
MICRO SEC
DB DBM
MINUTES
DBRN
TRMT HZ
RCV HZ
DB
COUNTS
CHECK SIG
POWER
ON
OFF
IMPULSE NOISE
THRESHOLD DBRN
REMOTE
5 MIN
15 MIN
NON-STOP
STOP
START
RESET
MASTER
TO SLAVE
SLAVE TO
MASTER
NORMAL
MASTER
SLAVE
DELAY
NORMAL
REPEAT
TRANSMITTER
FREQUENCY
OUTPUT LEVEL
FINE
MANUAL
DOWN
STEP
100 HZ
UP
C MSG
NOISE
FILTER
3KHZ FLAT
MEASUREMENT
NOISE WITH
TONE
SIGNAL TO
NOISE
MESSAGE
CKT NOISE
IMPULSE
NOISE
LEVEL &
FREQUENCY
ENVELOPE
DELAY
NONLINEAR
DISTORTION
NLD
CHECK
LEVEL
ZERO
DELAY
ZERO
RCV
TRMT
TRMT
TIP
RCV
TIP
RING
RING
HANDSET
CONNECTED
TO TRMT
DIAL
310
310
SETUP CONTROLS
NORMAL
TEST
DIAL
TALK
TEST
WITHOUT
HOLD
TEST
WITH
HOLD
TALK
BATTERY
ON
TALK
BATTERY
OFF
TERM
BRIDGE
RECEIVE
600
900
NO SF
SKIP
SF
SKIP
NORMAL
TEST
SELF
CHECK
LINE MONITOR
VOLUME

SELF-CHECK

NOTE

The SELF CHECK routine automatically makes an operational check of the test set, including its ability to operate in MASTER and SLAVE modes. The test set will automatically step through the SELF CHECK routine and should produce indications at each step as indicated below. At the end of the SELF CHECK routine, the display will indicate PASS if all checks are within specifications. If any steps fail to pass, the display will indicate failure codes at the end of the routine for those steps that fail to pass. A list of SELF CHECK failure codes, and their meanings are given at the end of this procedure.

The SELF CHECK procedure should be performed periodically to verify performance of the test set. SELF CHECK is recommended before transporting the test set to a remote testing site, or whenever there is any doubt about transmission measurement results.

1. PRELIMINARY SETUP
   a. Disconnect test set from on-line testing.
   b. Switch POWER ON.
   c. Loop TRMT jack to RCV jack. Operate RCV/TRMT jack field switch and observe that corresponding dot lamps light.
   d. Set all SETUP CONTROLS Switches to "up" positions.
   e. Set NORMAL TEST – SELF CHECK Switch to SELF CHECK.
2. STEP 1: DISPLAY AND ANNUNCIATOR CHECKS
   a. Observe that left display indicates +888.8 and that right display indicates 8888. Observe that all numerical segments are present and evenly illuminated.
   b. Observe that all display annunciators (except the minus sign) are on and evenly illuminated.
   c. Observe that MASTER TO SLAVE and SLAVE TO MASTER dot lights are on.

NOTE

It is not necessary to observe the following test routine unless it is desired to analyze a specific problem with the test set. SELF CHECK status will be displayed at the end of the routine.

3. STEPS 2-4: LEVEL & FREQUENCY CHECKS
   a. Left display should indicate +0.0 DBM (±0.3 dBm). Right display should indicate 1004 RCV HZ (±2 Hz).
   b. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 204 RCV HZ (±2 Hz).
   c. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 3904 RCV HZ (±2 Hz).
4. STEPS 5-7: C-MESSAGE FILTER CHECKS
   a. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 1004 RCV HZ (±2 Hz).
   b. Left display should indicate +16.0 DB (±1.0 dB). Right display should indicate 304 RCV HZ (±2 Hz).
   c. Left display should indicate +2.5 DB (±1.0 dB). Right display should indicate 3004 RCV HZ (±2 Hz).

(continued on next page)

5. STEPS 8-10: 3 KHZ FLAT FILTER CHECKS
   a. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 1004 RCV HZ (±2 Hz).
   b. Left display should indicate +0.0 DB (±0.5 dB). Right display should indicate 304 RCV HZ (±2 Hz).
   c. Left display should indicate +3.0 DB (±2.0 dB). Right display should indicate 3004 RCV HZ (±2 Hz).
6. STEP 11: NOISE-WITH-TONE NOTCH CHECK
   a. Left display should indicate greater than +50 DBM. Right display should indicate 1004 RCV HZ (±2 Hz).
7. STEP 12: IMPULSE NOISE CHECK
   a. Right display should indicate 70 COUNTS (±4 Counts).
8. STEP 13: ENVELOPE DELAY CHECK
   a. Left display should reset to 0 MICROSECONDS, then indicate 3000 MICROSECONDS (±10μS). Right display should indicate 1804 RCV HZ (±2 Hz).
9. STEPS 14-16: NONLINEAR DISTORTION CHECKS
   a. Left display should indicate 2 20 DB (±1 dB). Right display should indicate 3 20 DB (±1 dB).
   b. Left display should indicate greater than 2 60 DB. Right display should indicate greater than 3 60 DB.
   c. Left display should indicate +0 DBM (±1 dB).
10. STEP 17: SELF CHECK STATUS DISPLAY
   a. If all SELF CHECK tests are within specifications, the display will indicate PASS until the NORMAL TEST-SELF CHECK switch is returned to the NORMAL TEST position. The test set has passed, in addition to the above visible tests, an ENVELOPE DELAY response time test, an IMPULSE NOISE time base generator test, and a complete check of the modem used for MASTER-SLAVE operation.
   b. If the instrument fails to pass any of the above tests, failure codes will be displayed indicating the tests that have failed. These codes will be displayed sequentially until the NORMAL TEST-SELF CHECK switch is returned to the NORMAL TEST position. The table at right shows interpretations of the SELF CHECK failure codes that can be displayed.
11. SELF CHECK – MODEM ONLY.

If a quick SELF CHECK of only the modem is desired, the following procedure can be used:

   a. Perform PRELIMINARY SETUP procedures (a) through (d).
   b. Switch to SELF CHECK. Depress and hold DELAY ZERO Switch until left display indicates "PASS", then release.
   c. If modem passes SELF CHECK, display will immediately indicate PASS. Refer to failure codes, at right, if failure code is displayed.

SELF-CHECK FAILURE CODES

CODE	MESSAGE
H16	Test signal not looped around.
H20	Level out of tolerance at 204 Hz (STEP 3).
H21	Level out of tolerance at 1004 Hz (STEP 2).
H22	Level out of tolerance at 3904 Hz (STEP 4).
H30	C-Message Filter out of tolerance at 304 Hz (STEP 6).
H31	C-Message Filter out of tolerance at 1004 Hz (STEP 5).
H32	C-Message Filter out of tolerance at 3004 Hz (STEP 7).
H33	Noise-With-Tone notch filter out of tolerance (STEP 11).
H34	Impulse Noise counts out of tolerance (STEP 12).
H35	3KHZ FLAT Filter out of tolerance at 304 Hz (STEP 9).
H36	3KHZ FLAT Filter out of tolerance at 1004 Hz (STEP 8).
H37	3KHZ FLAT Filter out of tolerance at 3004 Hz (STEP 10).
H38	Impulse Noise time base generator out of tolerance (STEP 12).
H40	Frequency out of tolerance at 1004 Hz (STEP 2).
H41	Frequency out of tolerance at 204 Hz (STEP 3).
H42	Frequency out of tolerance at 3904 Hz (STEP 4).
H60	Non-Linear Distortion receiver out of tolerance (STEP 14).
H61	Non-Linear Distortion transmitter output level out of tolerance (STEP 16).
H62	Non-Linear Distortion receiver detector not working (STEP 14).
H63	Non-Linear Distortion residual noise out of tolerance (STEP 15).
H70	Envelope Delay response time out of tolerance (STEP 13).
H71	Envelope Delay accuracy out of tolerance (STEP 13).
H72	Envelope Delay 83-1/3 modulation missing (STEP 13).
H80 H81 H82 H83 H84	Test set modem does not pass SELF CHECK (NOTE: Failure of the modem affects only MASTER – SLAVE operation. Normal operation is not affected.)

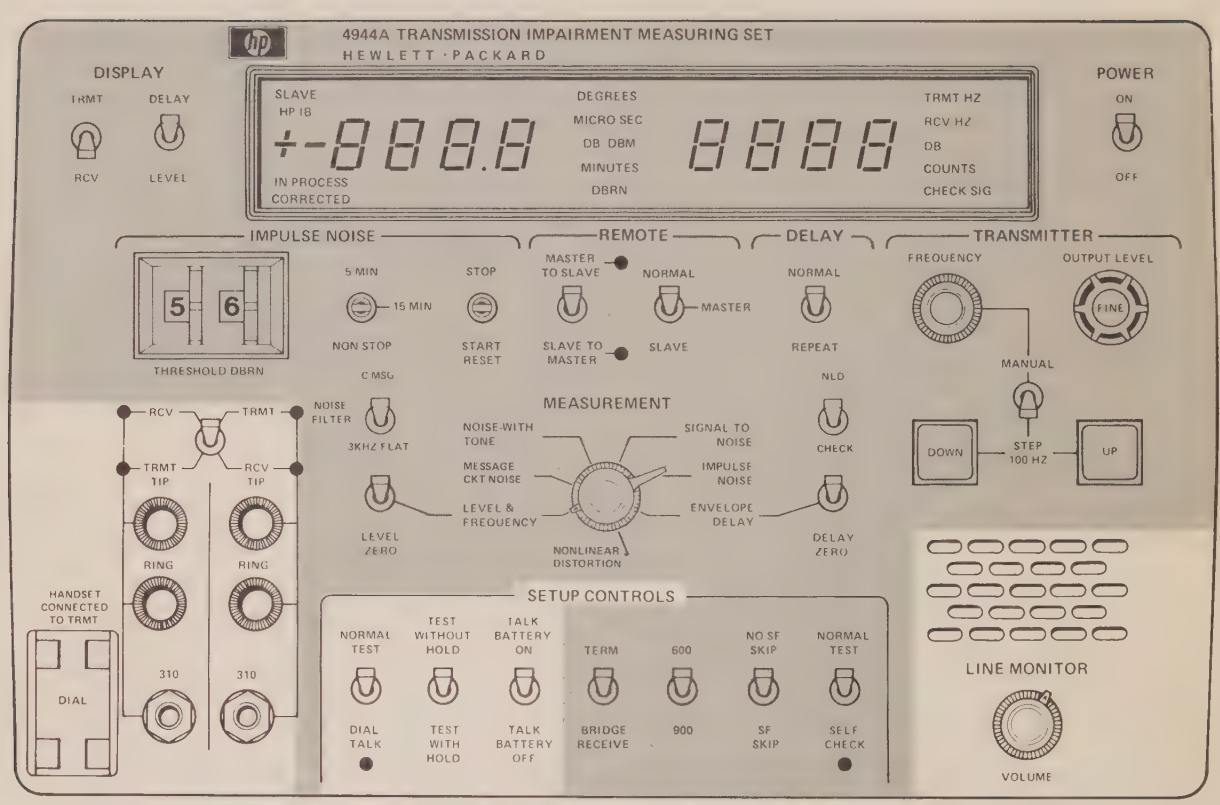
CONDITION CODES

Under certain conditions, the 4944A will abort or fail to achieve its normal display and indicate a "condition code" in the display. Following is a list of condition codes that can occur, their messages, probable causes, and recommended remedial actions to clear the condition. (Also refer to SELF CHECK procedure for listing of SELF CHECK failure codes).

CONDITION CODE	MESSAGE	PROBABLE CAUSES	RECOMMENDED ACTIONS
H-00	Front panel controls changed while MASTER attempting to achieve control over SLAVE.	1. Operator error.	1. Do not touch controls until dot light illuminates.
H-01	No data carrier received from SLAVE.	1. SLAVE OUTPUT LEVEL set too low.	1. Check SLAVE OUTPUT LEVEL.
		2. Excessive circuit loss.	2. Check that MASTER receives at least –40 dBm.
		3. 4944A problem.	3. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.
H-02, H-11	No data information received from SLAVE.	1. Excessive noise on circuit.	1. Check circuit noise and impulse noise.
		2. 4944A problem.	2. Perform SELF CHECK on SLAVE unit. Return test set for repair if necessary.
H-03, H-04	Data errors.	1. Excessive noise on circuit.	1. Check circuit noise and impulse noise.
		2. 4944A problem.	2. Perform SELF CHECK on MASTER unit. Return test set for repair if necessary.
H-05	Inappropriate response to MASTER-SLAVE commands.	1. 4944A problem.	1. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.
		2. Distortion on circuit due to high level or circuit malfunction.	2. Check MASTER and SLAVE OUTPUT LEVELS.
H-06	SLAVE not responding to MASTER command.	1. MASTER OUTPUT LEVEL set too low.	1. Check MASTER OUTPUT LEVEL.
		2. Excessive circuit loss.	2. Check that SLAVE receives at least –40 dBm.
		3. Excessive noise on circuit.	3. Check circuit noise and impulse noise.
		4. 4944A problem.	4. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.

CONDITION CODE	MESSAGE	PROBABLE CAUSES	RECOMMENDED ACTIONS
H-07	Incompatible SLAVE measurement.	1. SLAVE is being requested to make a measurement it is not capable of making.	1. SLAVE must be compatible with MASTER (or it aborts to LINE LOOP BACK mode for measurements not available in SLAVE unit).
H-08	Invalid command.	1. 4944A problem.	1. Perform SELF CHECK on MASTER unit. Return test set for repair if necessary.
H-09	No data received when expected.	1. Circuit dropout. 2. SLAVE OUTPUT CONTROL moved during data transmission. 3. 4944A problem.	1. Check circuit; re-run test. 2. Do not touch SLAVE OUTPUT control while measurement in progress. 3. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.
H-10	SLAVE Underrange; test Level or Noise below range capability.	1. Receive LEVEL less than −70 dBm. 2. Receive NOISE less than +20 dBrn.	1. Normal condition; no action necessary.
H-11 See H-02			
H-12	IMPULSE NOISE	1. IMPULSE NOISE exceeded 9999 COUNTS.	1. Use shorter counting interval.
H-13	MASTER lost control of SLAVE.	1. SLAVE REMOTE Switch changed to NORMAL or MASTER during data transmission.	1. Do not touch SLAVE REMOTE Switch while measurement in progress.
H-14	Signal dropout >1 Sec. during IMPULSE NOISE measurement.	1. Circuit dropped out carrier.	1. Initiate new test.
H-15	Not used in 4944A		
H-16	Improper test signal.	1. Operator error.	1. Check for proper MEASUREMENT Switch position at sending test set.

DIAL, TALK, LISTEN, AND HOLD



DIAL, TALK, LISTEN, AND HOLD

1. Perform SETUP AND TURN ON procedure through step 9.
2. Connect lineman's handset (butt-in) to DIAL connectors.
3. Refer to table below for proper hookup and control settings.

NOTE

When selecting the SETUP CONTROLS-NORMAL TEST switch on 2-wire wet (DDD) line, make sure the SETUP CONTROLS switch is in the TEST WITH HOLD position before switching to NORMAL TEST. Failure to do so will cause the dial-up connection to be lost.

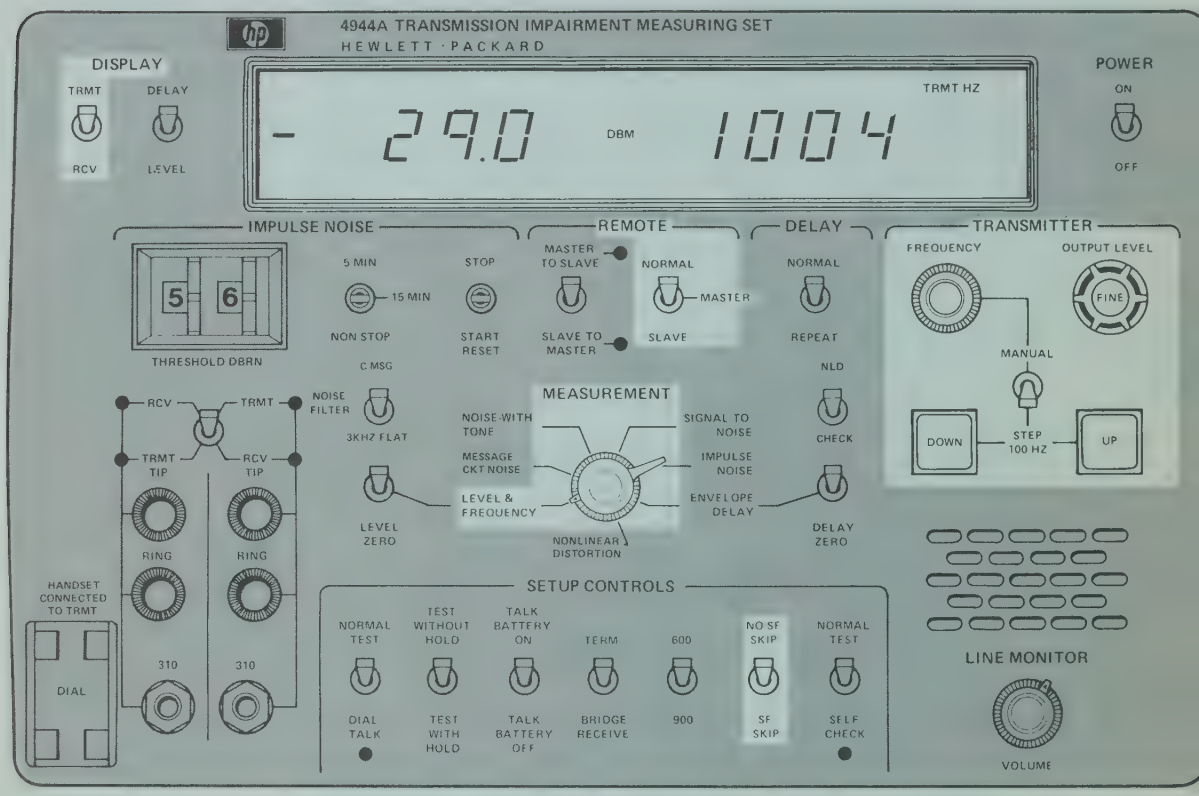
4. To return to talk or listen mode after normal tests are in progress, set SETUP CONTROLS switch to DIAL/TALK. Set RCV-TRMT jacks switch as indicated for 2-wire connection.

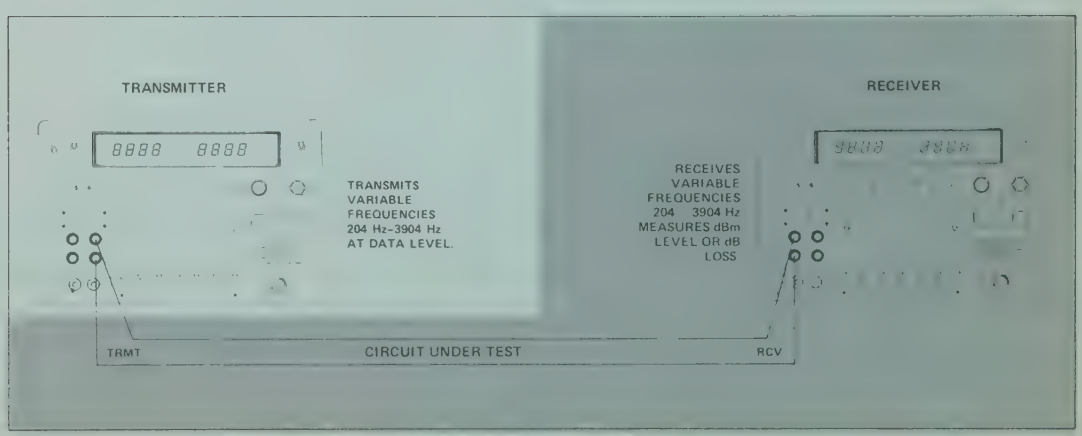
HOOKUP AND SETUP CONTROL SETTINGS FOR DIALING, TALKING, LISTENING, HOLDING AND TESTING

MODE	CIRCUIT		
	2-Wire Wet (DDD)	2-Wire Dry (DAA)	4-Wire Dry
HOOKUP	Transmit line connected to either RECEIVE/TRANSMIT JACKS	Transmit line connected to either RECEIVE/TRANSMIT JACKS	Transmit line connected to either RECEIVE/TRANSMIT JACKS
DIAL	DIAL/TALK; TALK BATTERY OFF; TEST WITHOUT HOLD; LEFT JACK TO TRMT (Dial with butt-in)		
TALK	DIAL/TALK; TALK BATTERY OFF; TEST WITH HOLD; LEFT JACK TO TRMT (Talk through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD; RIGHT JACK TO TRMT (Talk through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD (Talk through butt-in)
LISTEN	DIAL/TALK; TALK BATTERY OFF; TEST WITH HOLD; LEFT JACK TO TRMT (Listen through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD; RIGHT JACK TO TRMT (Listen through butt-in)	Adjust LINE MONITOR as required (Listen through LINE MONITOR speaker)
TEST	TALK BATTERY OFF; TEST WITH HOLD; NORMAL TEST, (Throw TEST WITH HOLD switch **before** throwing NORMAL TEST switch); LEFT JACK TO RCV IF RECEIVE TEST SET	TALK BATTERY ON; TEST WITHOUT HOLD; NORMAL TEST; RIGHT JACK TO RCV IF RECEIVE TEST SET	TALK BATTERY ON; TEST WITHOUT HOLD; NORMAL TEST

NORMAL OPERATION PROCEDURES

LEVEL AND FREQUENCY NORMAL TRANSMITTER




TRANSMITTER
TRANSMITS VARIABLE FREQUENCIES 204 Hz–3904 Hz AT DATA LEVEL.
RECEIVER
RECEIVES VARIABLE FREQUENCIES 204 3904 Hz MEASURES dBm LEVEL OR dB LOSS
TRMT
CIRCUIT UNDER TEST
RCV

LEVEL AND FREQUENCY NORMAL TRANSMITTER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to TRMT.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. If SF signaling units are used in the network under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
6. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP – DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

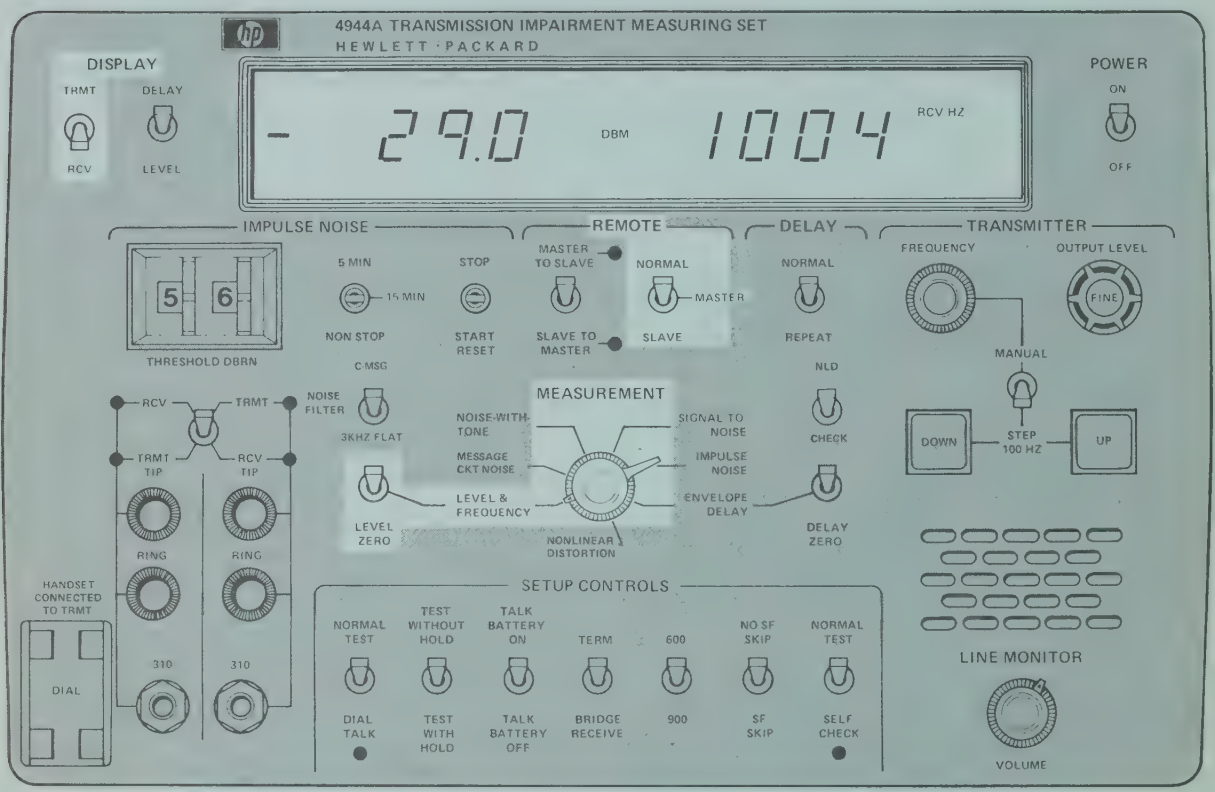
DATA LEVEL

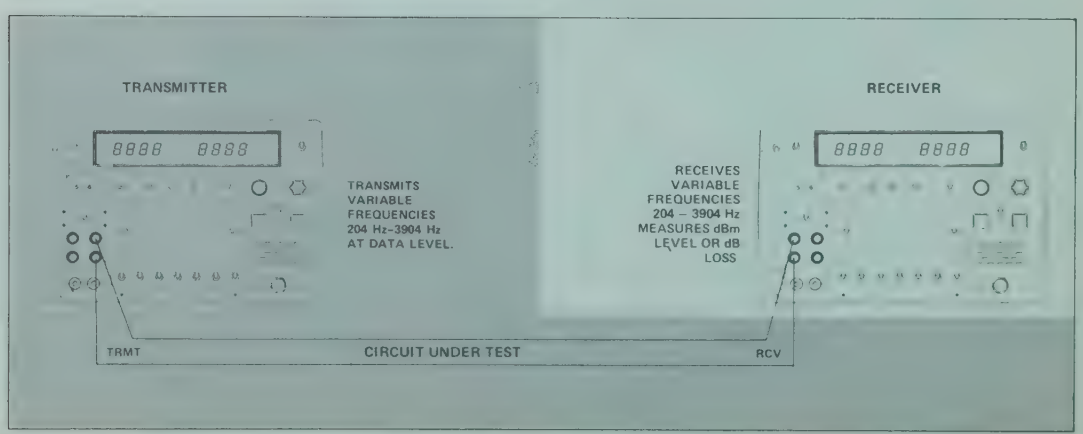
All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

8. When requested by NORMAL RECEIVER Operator, transmit agreed upon test frequencies. When in STEP 100 HZ mode, frequencies of 204 Hz to 3904 Hz can be selected. Frequencies other than those at the step points can be selected by setting the TRANSMITTER Switch to MANUAL and adjusting the FREQUENCY Control.

See next pages for NORMAL RECEIVER procedures.

LEVEL & FREQUENCY NORMAL RECEIVER




TRANSMITTER
RECEIVER
TRANSMITS VARIABLE FREQUENCIES 204 Hz–3904 Hz AT DATA LEVEL.
RECEIVES VARIABLE FREQUENCIES 204 – 3904 Hz MEASURES dBm LEVEL OR dB LOSS
TRMT
CIRCUIT UNDER TEST
RCV

LEVEL AND FREQUENCY NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to RCV.

1000 HZ LOSS MEASUREMENT

4. Instruct NORMAL TRANSMITTER Operator to send 1004 Hz tone.
5. Observe RCV HZ (nominally 1004 Hz) in right display and received DBM level in left display.

FREQUENCY SHIFT MEASUREMENT

6. Observe RCV HZ while communicating with NORMAL TRANSMITTER Operator. Compare any difference between the transmitted and received frequency.

NOTE

The transmitting test set must transmit a frequency known to within ±0.5 Hz, such as another Hewlett-Packard Transmission Impairment Measuring Set.

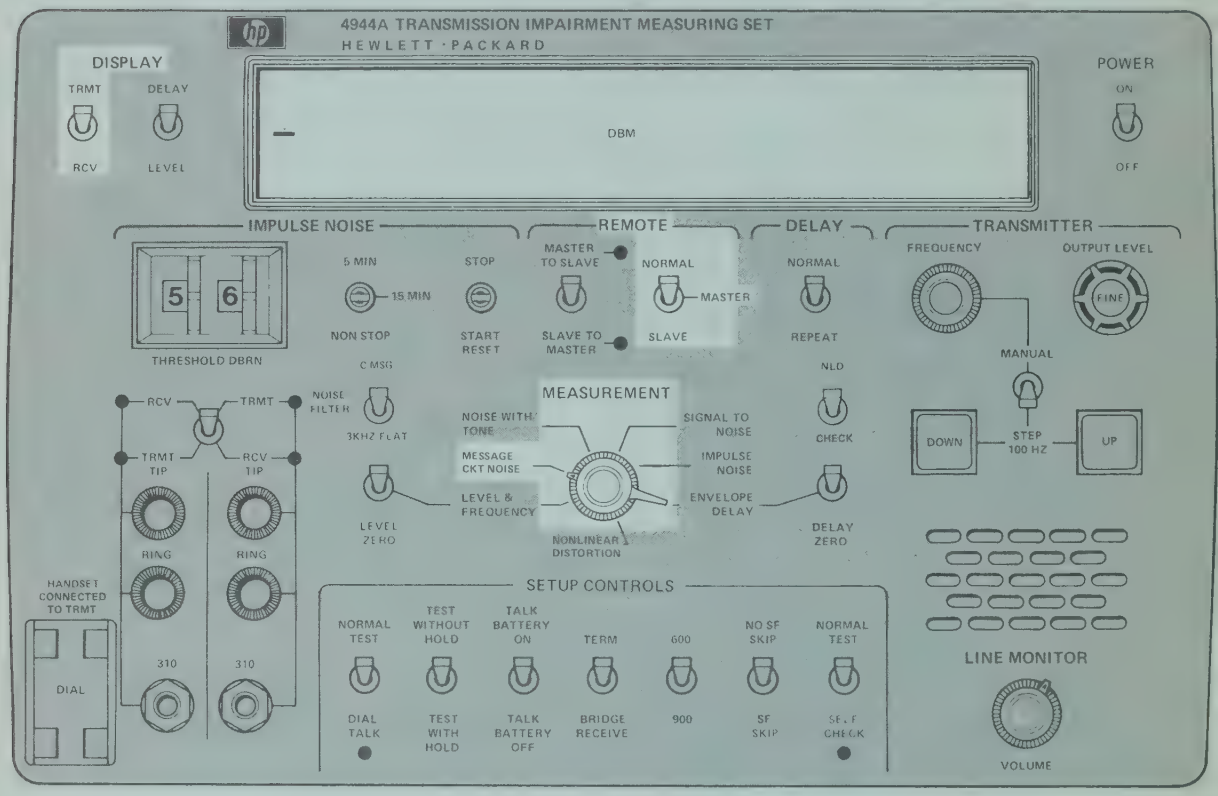
ATTENUATION DISTORTION MEASUREMENT

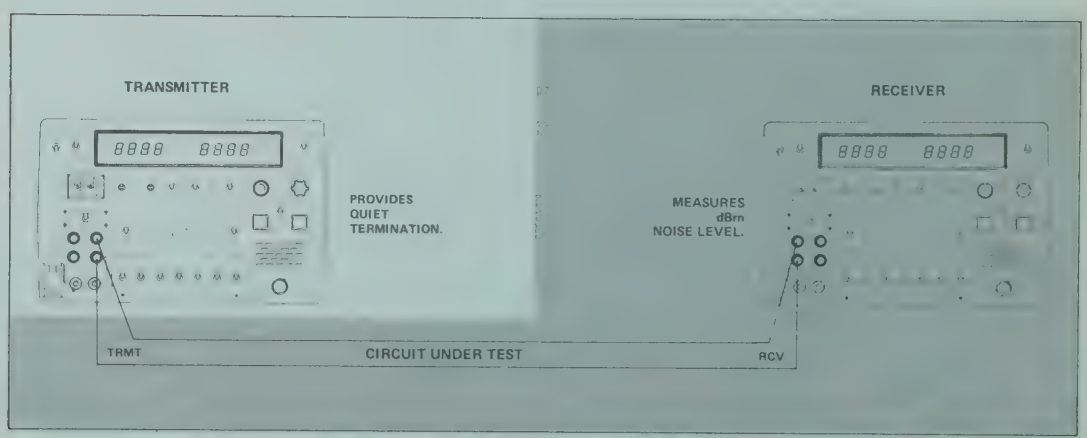
7. Momentarily hold down LEVEL ZERO Switch. This establishes a 0 dB reference at the reference frequency (1004 Hz).
8. Observe RCV HZ in right display and DB relative loss in left display, as agreed upon frequencies are transmitted. +DB indicates more loss and –DB indicates less loss, relative to the reference frequency.

NOTE

Attenuation Distortion measurements can also be made in absolute dBm. The test set is automatically in the dBm mode until the LEVEL ZERO Switch is operated. To return the test set to the dBm mode, momentarily rotate MEASUREMENT Switch to another position, then back to LEVEL & FREQUENCY again.

MESSAGE CIRCUIT NOISE NORMAL TRANSMITTER



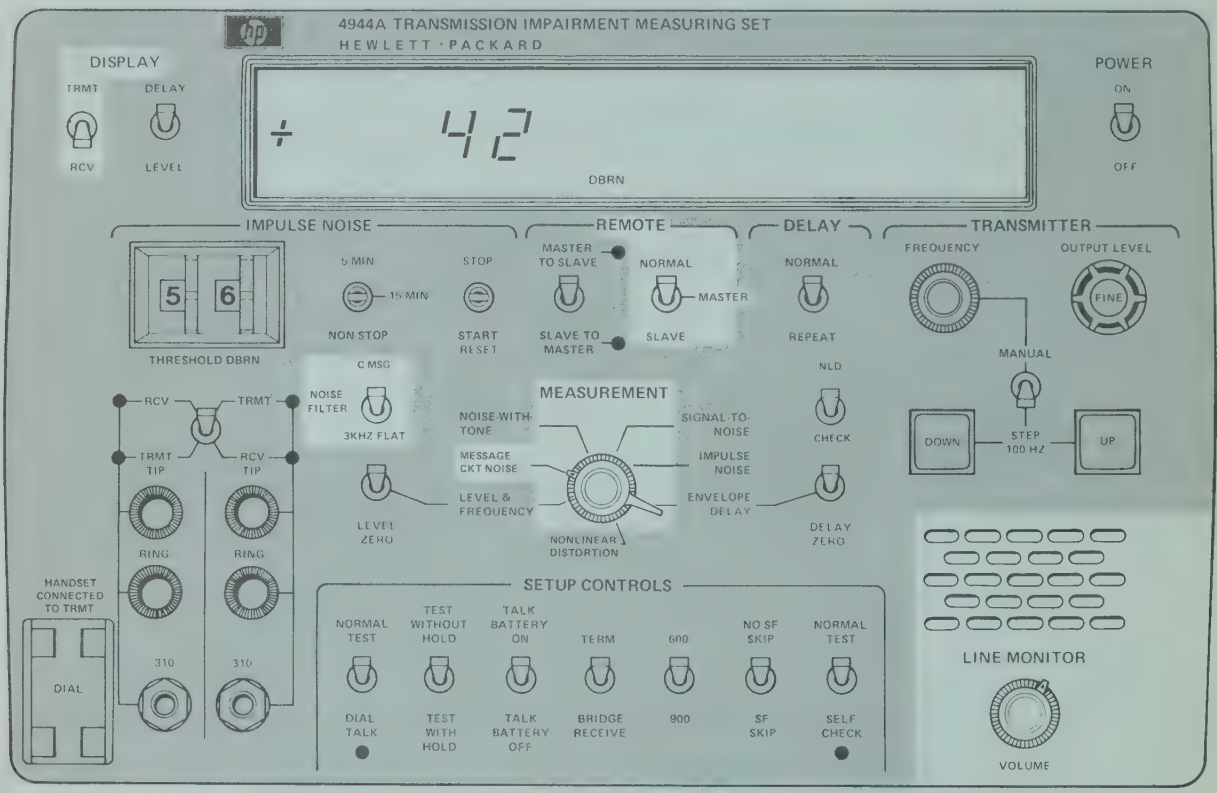


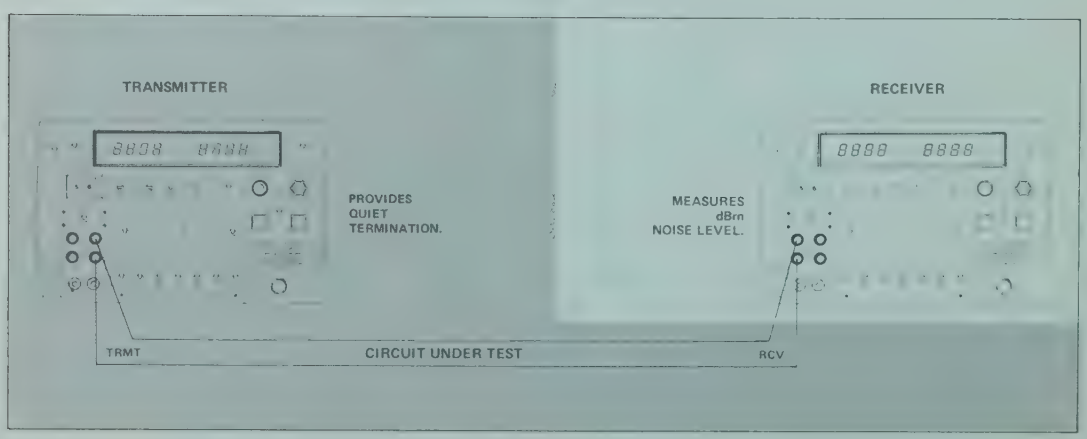
MESSAGE CIRCUIT NOISE NORMAL TRANSMITTER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to MESSAGE CKT NOISE. This provides the TRMT jack with a quiet termination.

See next pages for NORMAL RECEIVER procedures.

MESSAGE CIRCUIT NOISE NORMAL RECEIVER





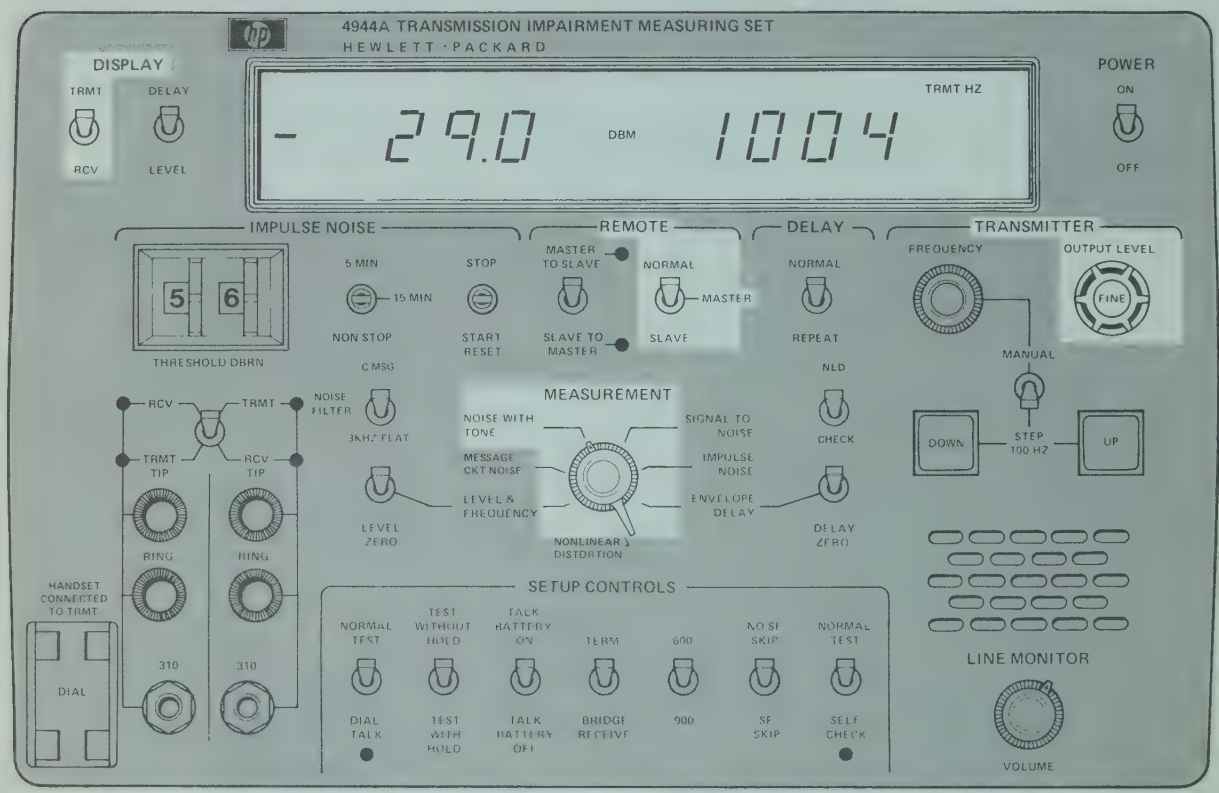
MESSAGE CIRCUIT NOISE NORMAL RECEIVER

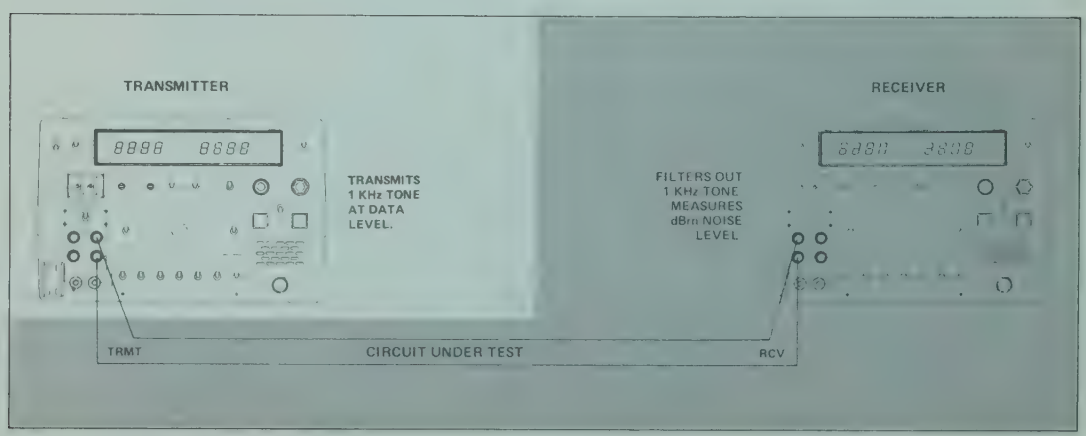
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to MESSAGE CKT NOISE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Observe DBRN noise level in left display. NOTE: A "–" sign in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

6. Turn on LINE MONITOR by adjusting VOLUME control until desired loudness is obtained in speaker. Listen for a predominant tone which will indicate a potential single frequency interference problem.

NOISE-WITH-TONE NORMAL TRANSMITTER





NOISE-WITH-TONE NORMAL TRANSMITTER

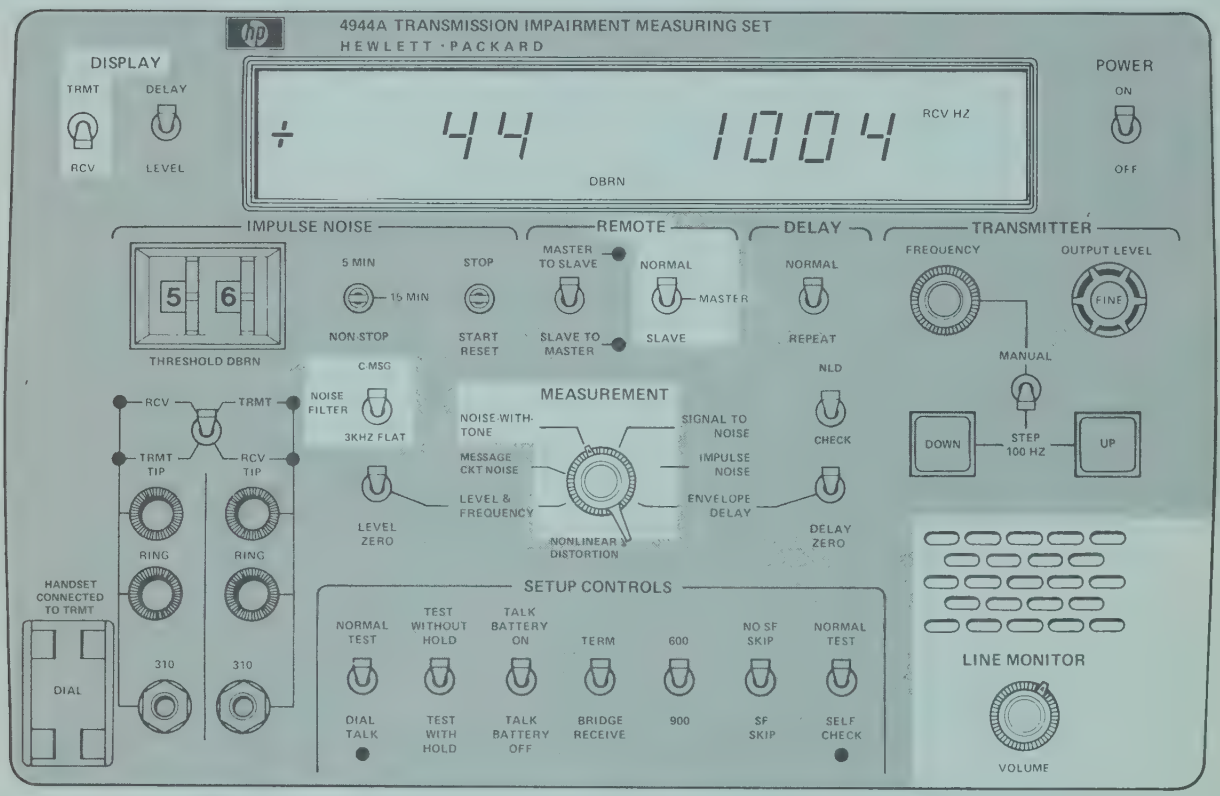
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NOISE-WITH-TONE.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

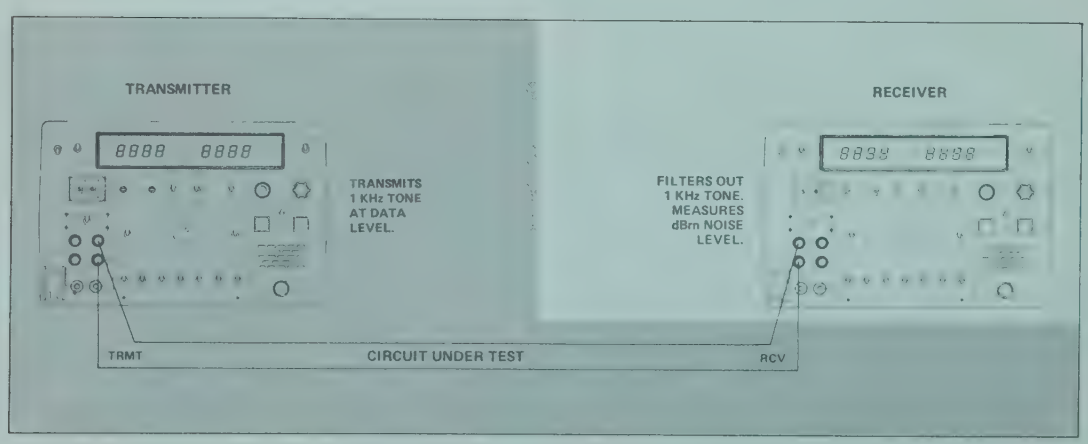
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

NOISE-WITH-TONE NORMAL RECEIVER

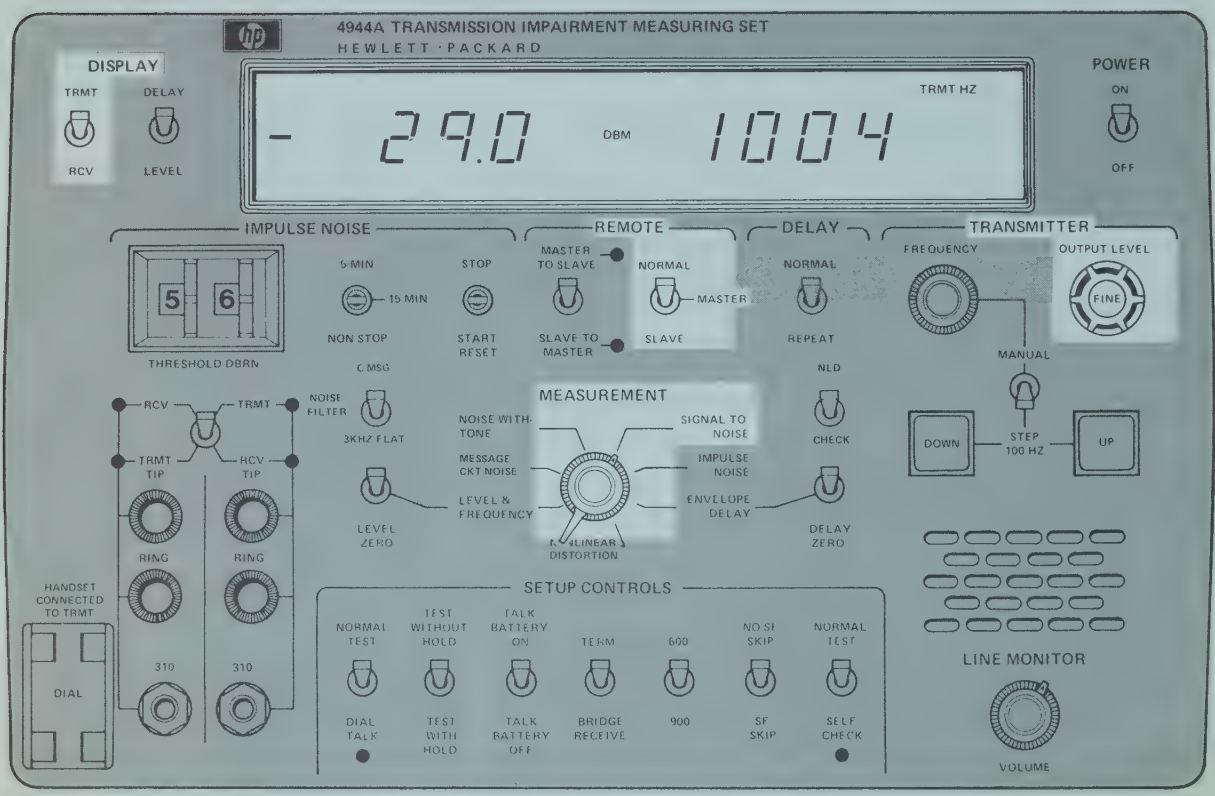


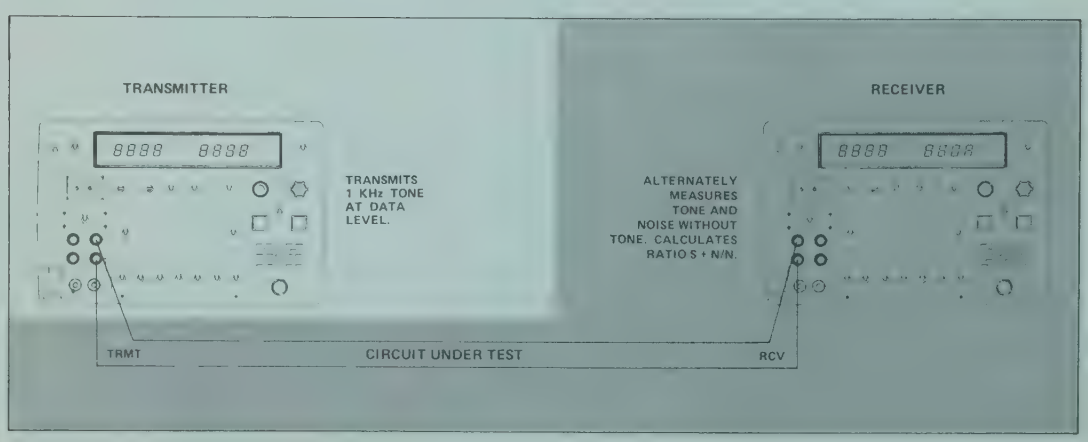


NOISE-WITH-TONE NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NOISE-WITH-TONE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Observe RCV HZ in right display. Verify that received frequency is between 995 Hz and 1025 Hz.
6. Turn on LINE MONITOR by adjusting VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.
7. Observe DBRN noise level in left display. NOTE: A "–" sign in left display indicates underrange (<20 DBRN).

SIGNAL-TO-NOISE NORMAL TRANSMITTER





SIGNAL-TO-NOISE NORMAL TRANSMITTER

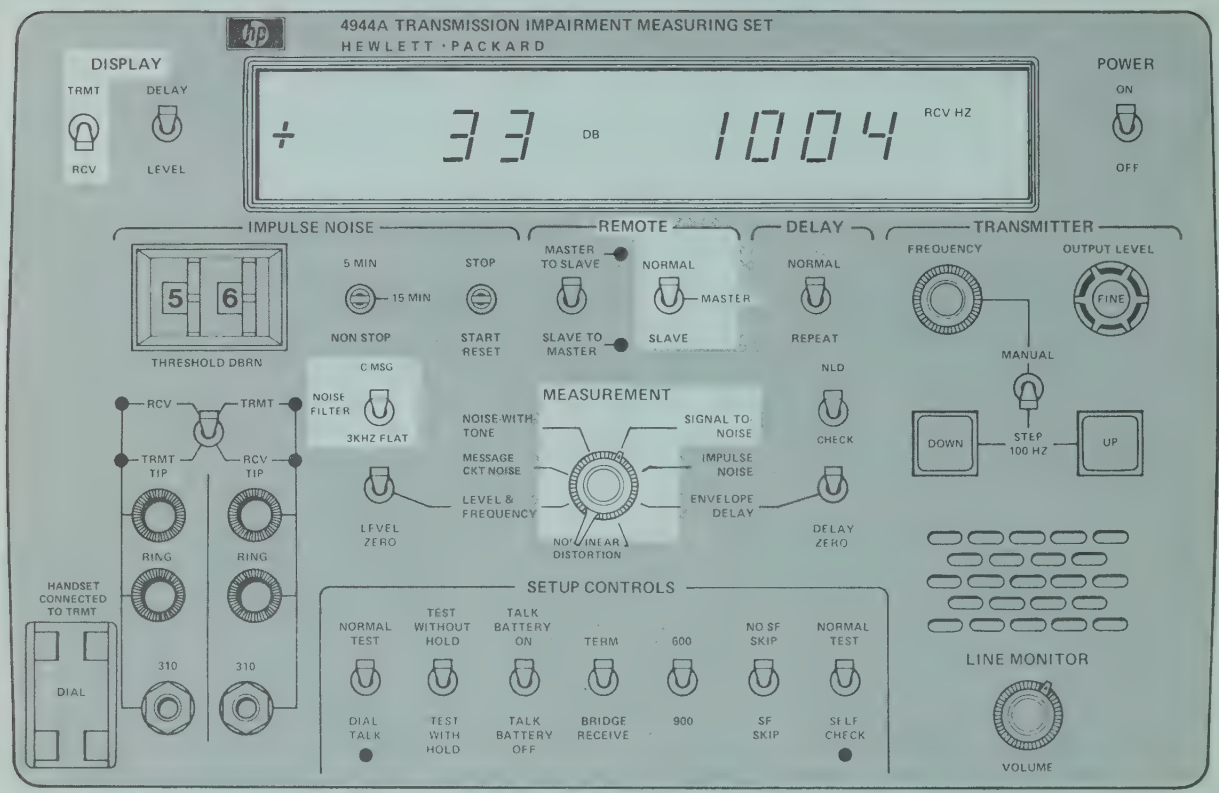
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to SIGNAL-TO-NOISE.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

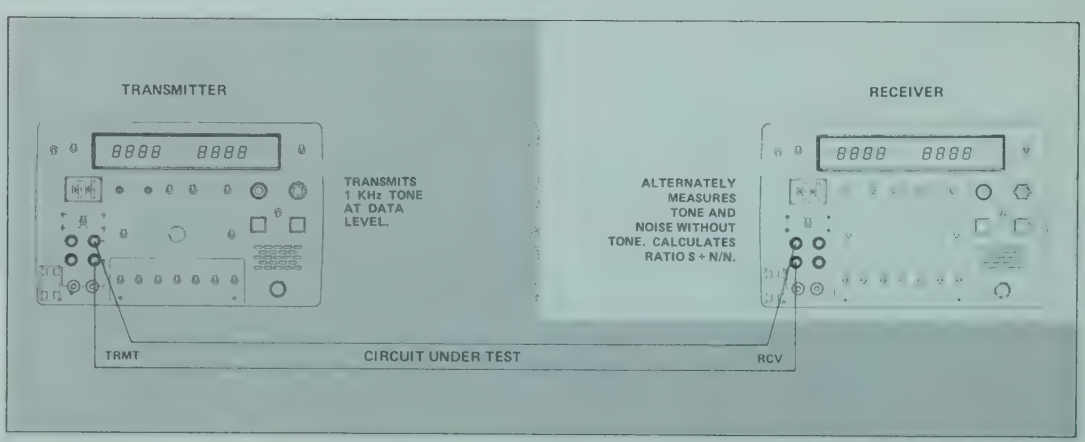
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

SIGNAL-TO-NOISE NORMAL RECEIVER

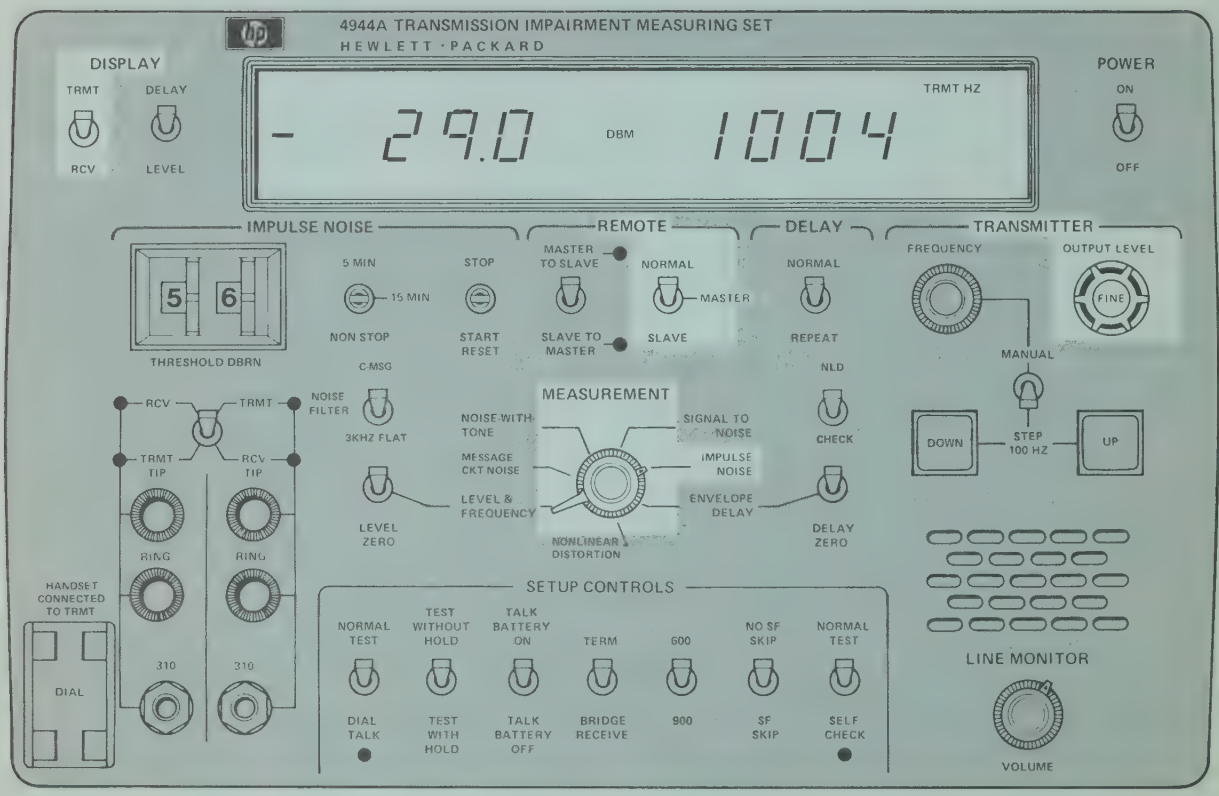


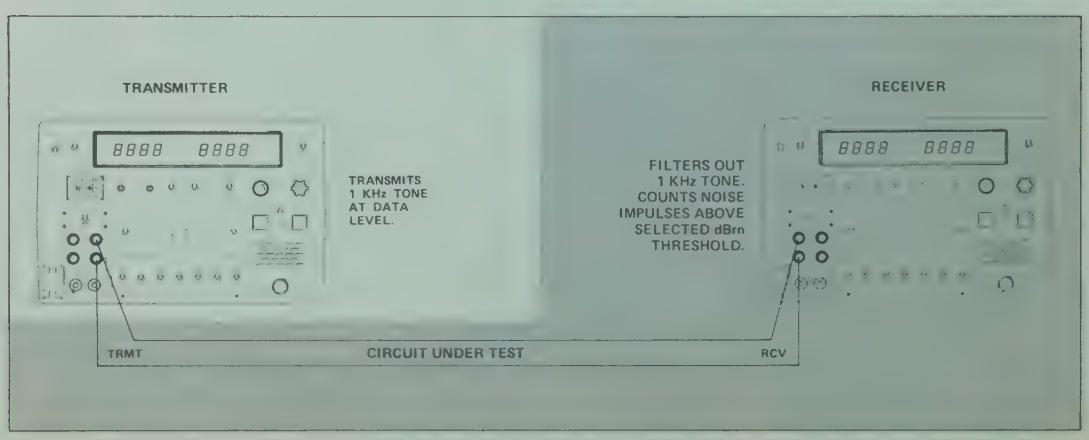


SIGNAL-TO-NOISE NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to SIGNAL-TO-NOISE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Observe RCV HZ in right display. Verify that received signal is between 995 Hz and 1025 Hz.
6. Observe DB signal-to-noise ratio (S+N/N) in left display. NOTE: A "–" sign in left display indicates underrange.

IMPULSE NOISE NORMAL TRANSMITTER





IMPULSE NOISE NORMAL TRANSMITTER

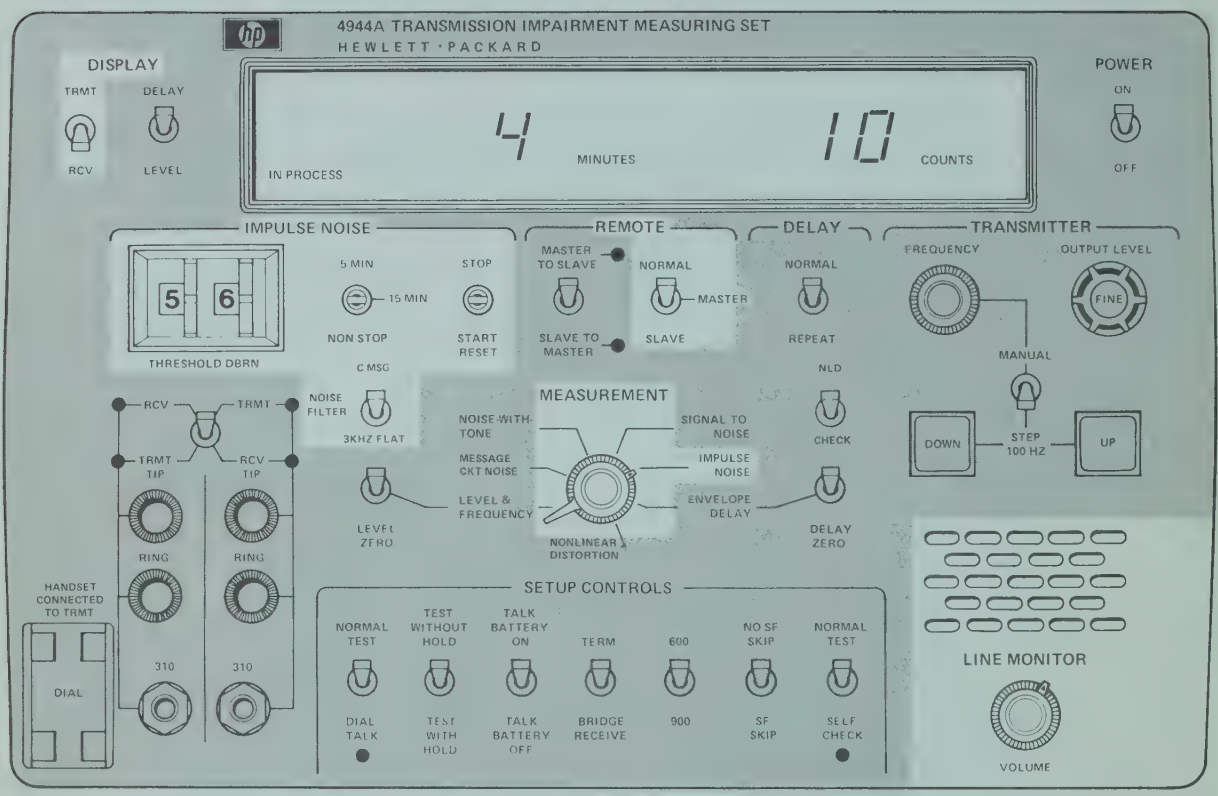
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to IMPULSE NOISE.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

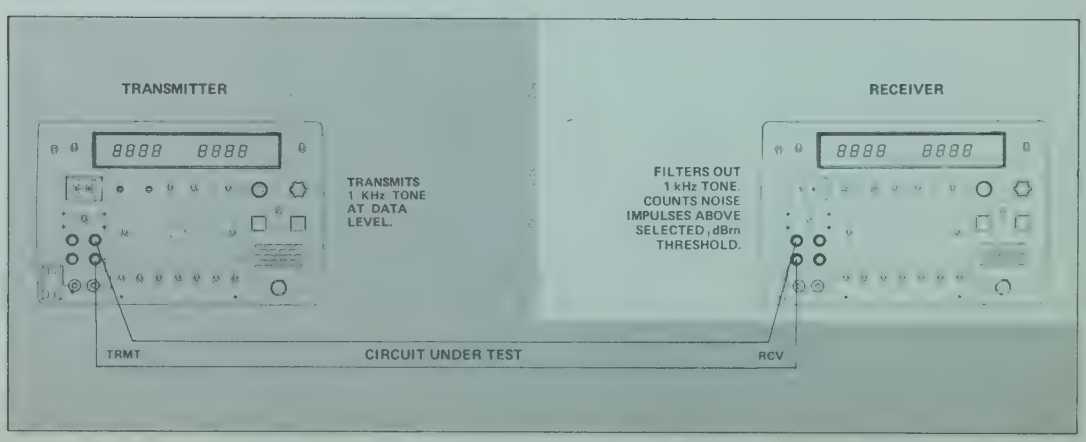
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

IMPULSE NOISE NORMAL RECEIVER





IMPULSE NOISE NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to IMPULSE NOISE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Set IMPULSE NOISE Thumbwheel Switches to desired DBRN THRESHOLD.
6. Set IMPULSE NOISE Switch to desired count interval (5 MIN, 15 MIN, or NON-STOP).
7. Momentarily hold down and release IMPULSE NOISE STOP-START/RESET Switch to START/RESET position. Observe that IN PROCESS Annunciator comes on.
8. Left display indicates count time (in minutes) remaining in 5 MIN and 15 MIN modes. Elapsed time is indicated for NON-STOP mode.

NOTE

If a carrier dropout of less than –40 dBm for more than one second occurs at any time during the counting interval, a minus (–) sign will be displayed in the left display. Presence of this sign may indicate an invalid test which should be re-run.

9. Observe that IN PROCESS Annunciator goes out at completion of 5 MIN or 15 MIN interval. Observe measured impulse noise COUNTS in right display.

NOTE

Count can be reset to zero and restarted at any time by momentarily holding switch to START/RESET position. Count can also be stopped at any time by momentarily holding switch to STOP position, however, count must be restarted at zero counts.

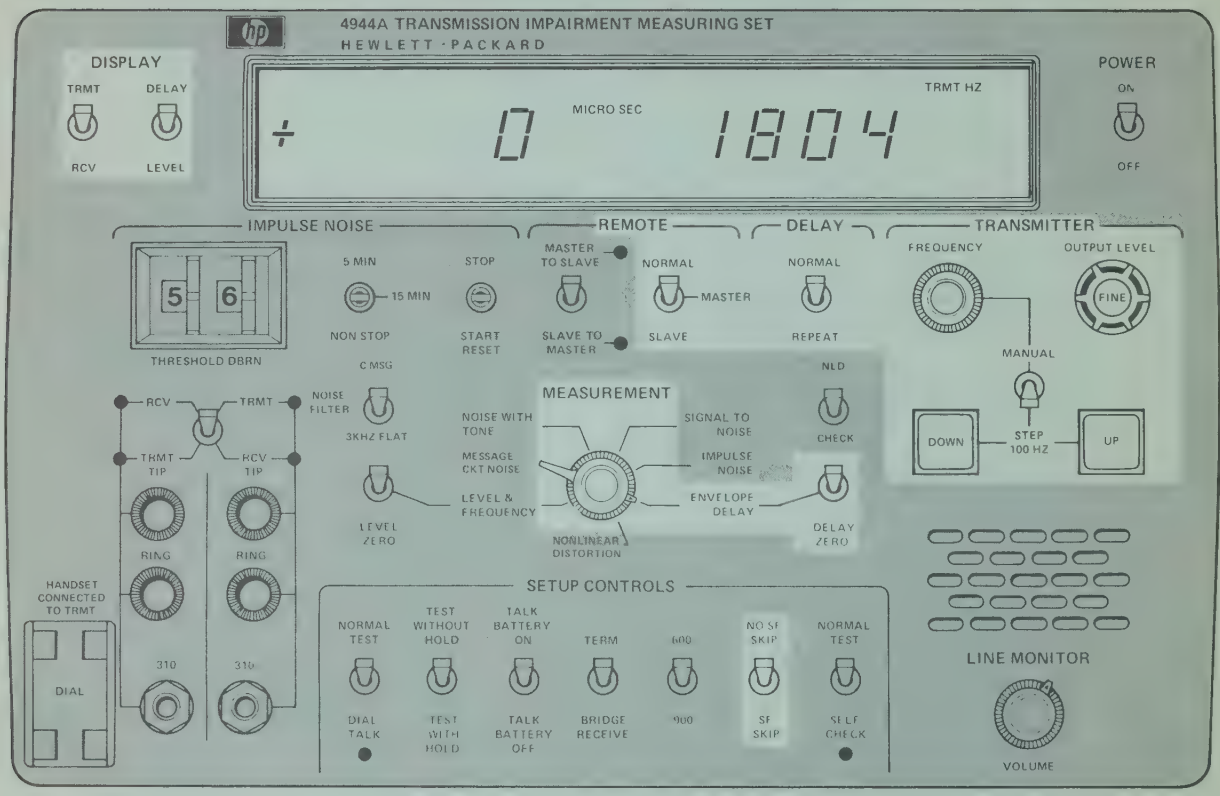
10. If NON-STOP mode is used, momentarily hold up and release IMPULSE NOISE STOP-START/RESET Switch to STOP position at end of desired counting interval. Observe measured impulse noise COUNTS in right display.

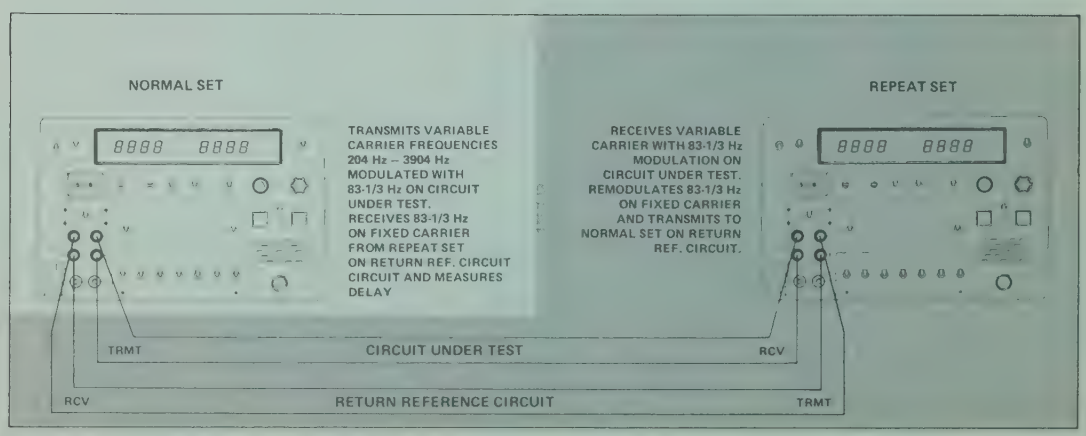
NOTE

The right display has a maximum capacity of 9999 COUNTS. If this capacity is exceeded, the display will indicate "H-12" to indicate "accumulator overflow condition".

11. Turn on LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

ENVELOPE DELAY-RETURN REFERENCE NORMAL TEST SET




NORMAL SET
REPEAT SET
TRANSMITS VARIABLE CARRIER FREQUENCIES 204 Hz – 3904 Hz MODULATED WITH 83-1/3 Hz ON CIRCUIT UNDER TEST. RECEIVES 83-1/3 Hz ON FIXED CARRIER FROM REPEAT SET ON RETURN REF. CIRCUIT CIRCUIT AND MEASURES DELAY
RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION ON CIRCUIT UNDER TEST. REMODULATES 83-1/3 Hz ON FIXED CARRIER AND TRANSMITS TO NORMAL SET ON RETURN REF. CIRCUIT.
TRMT
CIRCUIT UNDER TEST
RCV
RCV
RETURN REFERENCE CIRCUIT
TRMT

ENVELOPE DELAY-RETURN REFERENCE NORMAL TEST SET

1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to TRMT Jack. Connect Return Reference pair to RCV Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to NORMAL.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

7. When *Repeat Test Set* operator has completed *his Step 7*, set DISPLAY Switch to RCV.
8. Notify *Repeat Test Set* operator that you have completed *your Step 7.*
9. Observe received DBM level in left display. This level must be –40 dBm or greater for valid measurements.
10. Set DISPLAY Switches to TRMT and DELAY.
11. Set TRANSMITTER Switch to STEP 100 HZ.
12. If SF signaling units are used in the network under test, set NO SF SKIP-SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
13. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
14. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

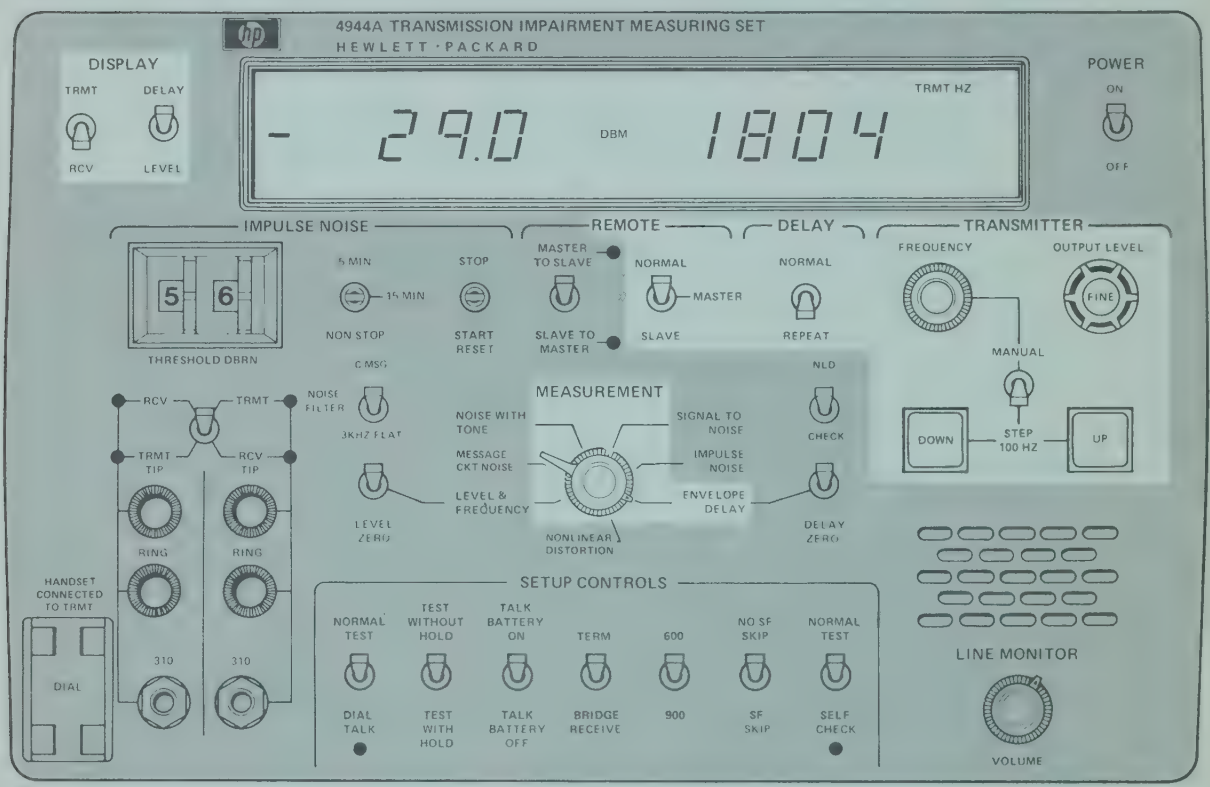
NOTE

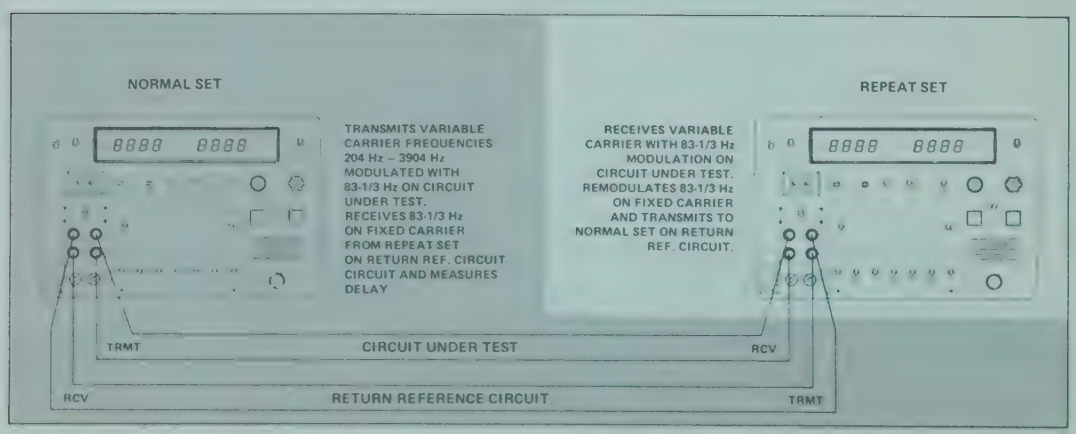
This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

15. Select desired test frequencies using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
16. At each test frequency, observe ± MICRO SEC envelope delay in left display. If readings vary, observe for an arithmetic mean (average).

See next pages for REPEAT TEST SET procedures.

ENVELOPE DELAY-RETURN REFERENCE REPEAT TEST SET




NORMAL SET
TRANSMITS VARIABLE CARRIER FREQUENCIES 204 Hz – 3904 Hz MODULATED WITH 83-1/3 Hz ON CIRCUIT UNDER TEST. RECEIVES 83-1/3 Hz ON FIXED CARRIER FROM REPEAT SET ON RETURN REF. CIRCUIT CIRCUIT AND MEASURES DELAY
REPEAT SET
RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION ON CIRCUIT UNDER TEST. REMODULATES 83-1/3 Hz ON FIXED CARRIER AND TRANSMITS TO NORMAL SET ON RETURN REF. CIRCUIT.
TRMT
CIRCUIT UNDER TEST
RCV
RCV
RETURN REFERENCE CIRCUIT
TRMT

ENVELOPE DELAY-RETURN REFERENCE REPEAT TEST SET

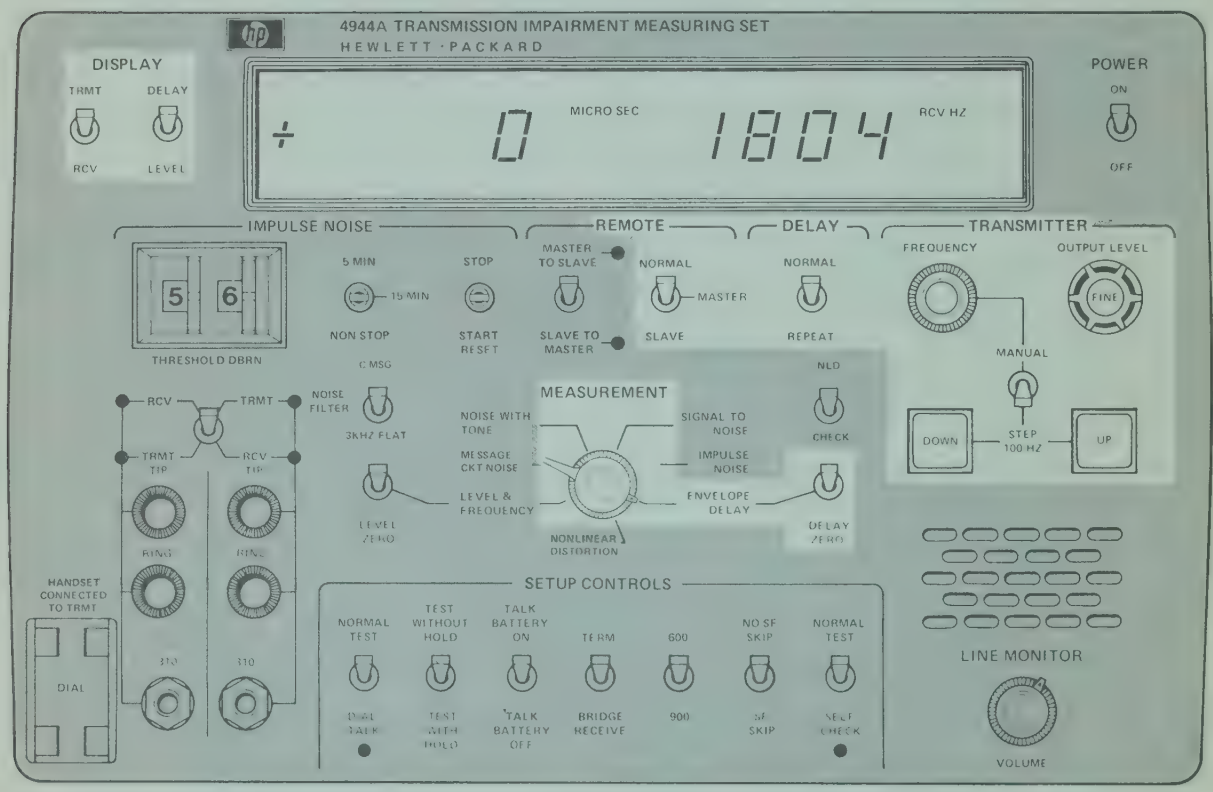
1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to RCV Jack. Connect Return Reference pair to TRMT Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to REPEAT.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

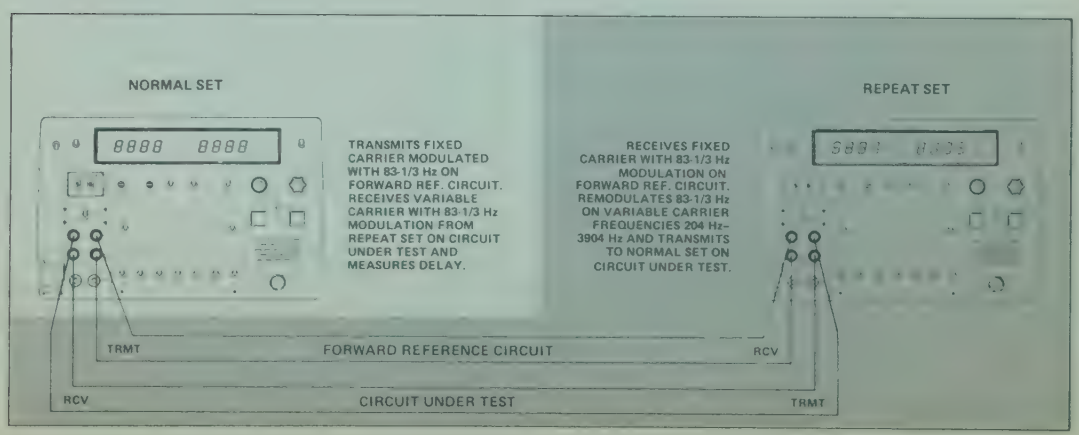
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

7. Set TRANSMITTER Switch to STEP 100 HZ. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
8. Notify *Normal Test Set* operator that you have completed *your Step 7.*
9. When *Normal Test Set* operator notifies you that he has completed *his Step 7,* set DISPLAY Switch to RCV.
10. Monitor DBM received level in left display to be sure it remains –40 dBm or greater throughout the measurements.

ENVELOPE DELAY-FORWARD REFERENCE NORMAL TEST SET




NORMAL SET
REPEAT SET
TRANSMITS FIXED CARRIER MODULATED WITH 83-1/3 Hz ON FORWARD REF. CIRCUIT. RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION FROM REPEAT SET ON CIRCUIT UNDER TEST AND MEASURES DELAY.
RECEIVES FIXED CARRIER WITH 83-1/3 Hz MODULATION ON FORWARD REF. CIRCUIT. REMODULATES 83-1/3 Hz ON VARIABLE CARRIER FREQUENCIES 204 Hz–3904 Hz AND TRANSMITS TO NORMAL SET ON CIRCUIT UNDER TEST.
TRMT
FORWARD REFERENCE CIRCUIT
RCV
RCV
CIRCUIT UNDER TEST
TRMT

ENVELOPE DELAY-FORWARD REFERENCE NORMAL TEST SET

1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to RCV Jack. Connect Forward Reference pair to TRMT Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to NORMAL.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set TRANSMITTER Switch to STEP 100 HZ. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
8. When *Repeat Test Set* operator has completed *his Step 9,* set DISPLAY Switch to RCV.
9. Notify *Repeat Test Set* operator that you have completed *your Step 7.*
10. Observe received DBM level in left display. This level must be −40 dBm or greater for valid measurements.
11. Set DISPLAY Switch to DELAY.
12. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

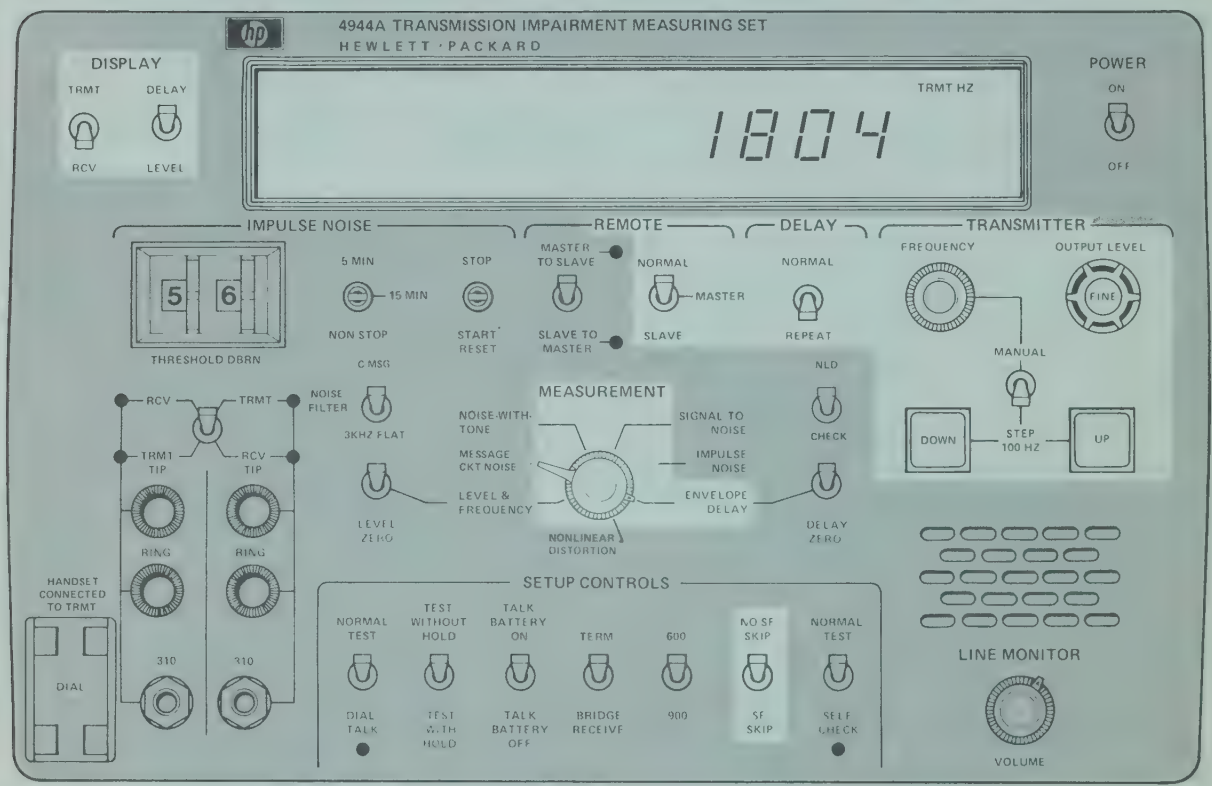
NOTE

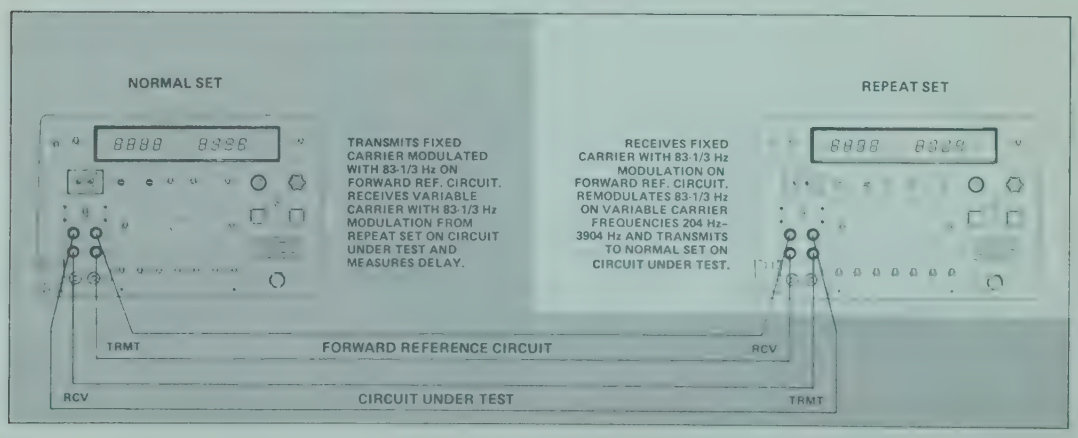
This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

13. Notify *Repeat Test Set* operator to begin sending the agreed upon test frequencies.
14. At each test frequency, observe ± MICRO SEC envelope delay in left display. If readings vary, observe for an arithmetic mean (average). Observe RCV HZ in right display.

See next pages for REPEAT TEST SET procedures.

ENVELOPE DELAY-FORWARD REFERENCE REPEAT TEST SET




NORMAL SET
TRANSMITS FIXED CARRIER MODULATED WITH 83-1/3 Hz ON FORWARD REF. CIRCUIT. RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION FROM REPEAT SET ON CIRCUIT UNDER TEST AND MEASURES DELAY.
REPEAT SET
RECEIVES FIXED CARRIER WITH 83-1/3 Hz MODULATION ON FORWARD REF. CIRCUIT. REMODULATES 83-1/3 Hz ON VARIABLE CARRIER FREQUENCIES 204 Hz–3904 Hz AND TRANSMITS TO NORMAL SET ON CIRCUIT UNDER TEST.
TRMT
FORWARD REFERENCE CIRCUIT
RCV
RCV
CIRCUIT UNDER TEST
TRMT

ENVELOPE DELAY-FORWARD REFERENCE REPEAT TEST SET

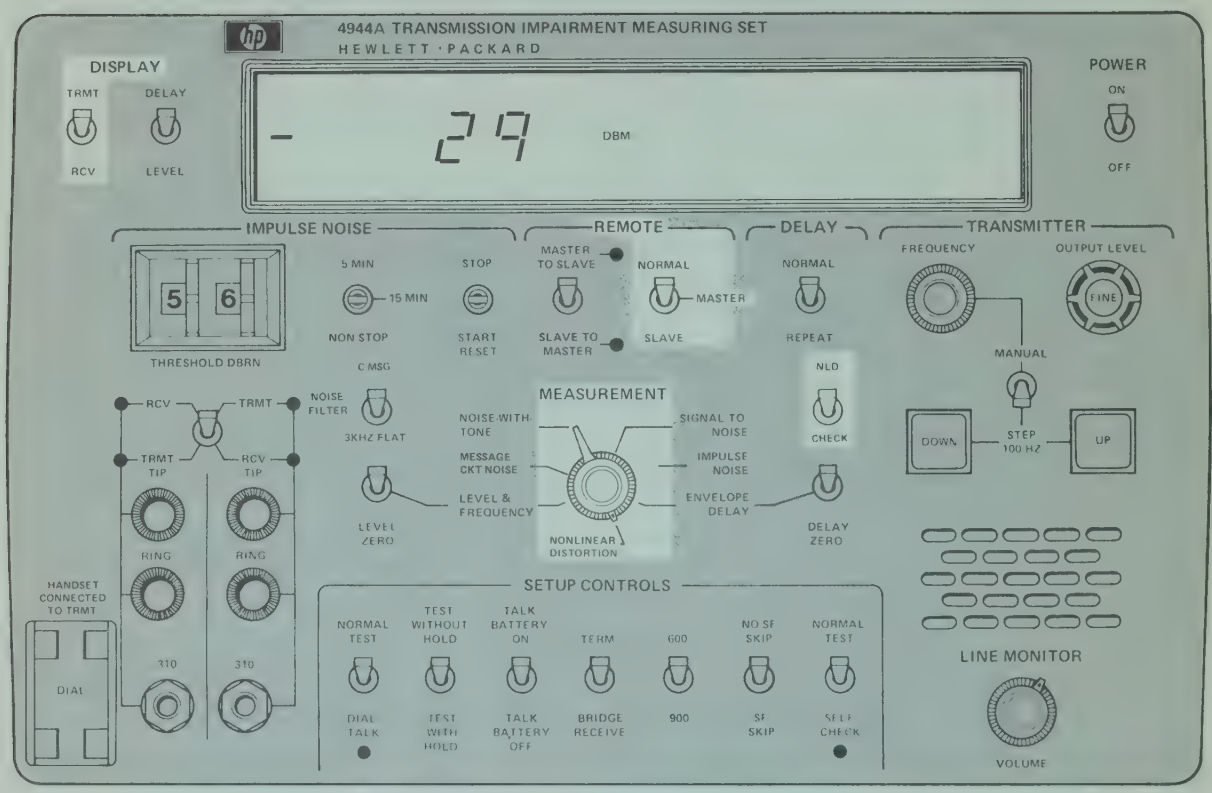
1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to TRMT Jack. Connect Forward Reference pair to RCV Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to REPEAT.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

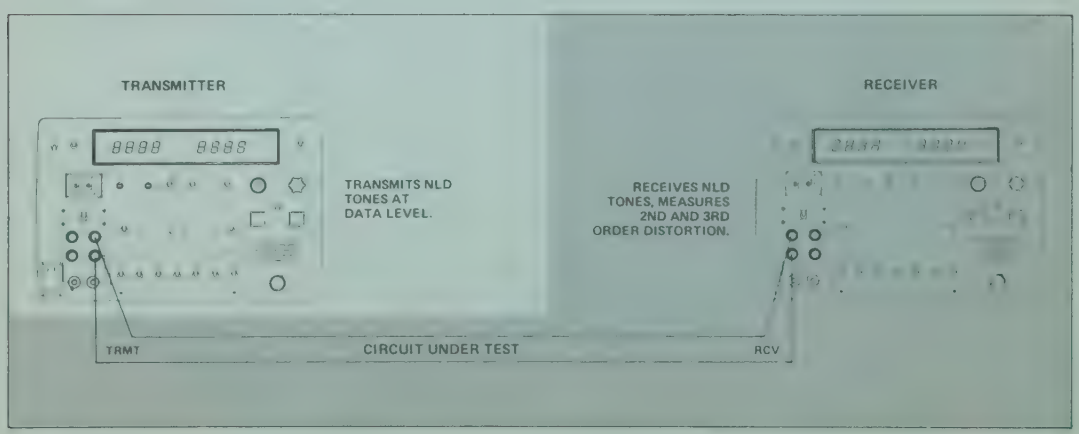
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set TRANSMITTER Switch to STEP 100 HZ.
8. If SF signaling units are used on the circuit under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
9. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
10. Notify *Normal Test Set* operator that you have completed *your Step 9.*
11. When *Normal Test Set* operator notifies you that he has completed *his Step 7,* set DISPLAY Switch to DELAY.
12. When requested by *Normal Test Set* operator, transmit agreed upon frequencies using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.

NONLINEAR DISTORTION NORMAL TRANSMITTER





NONLINEAR DISTORTION NORMAL TRANSMITTER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NONLINEAR DISTORTION.
3. Set DISPLAY Switch to TRMT.
4. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

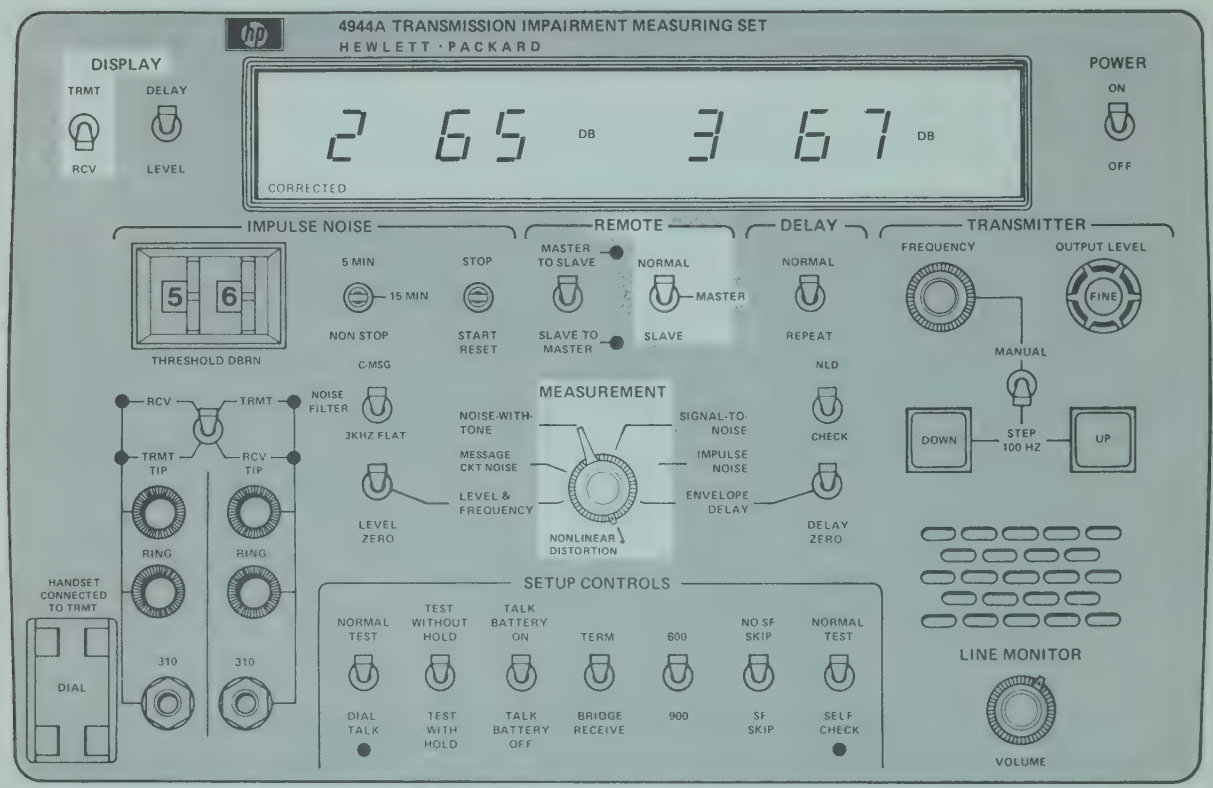
DATA LEVEL

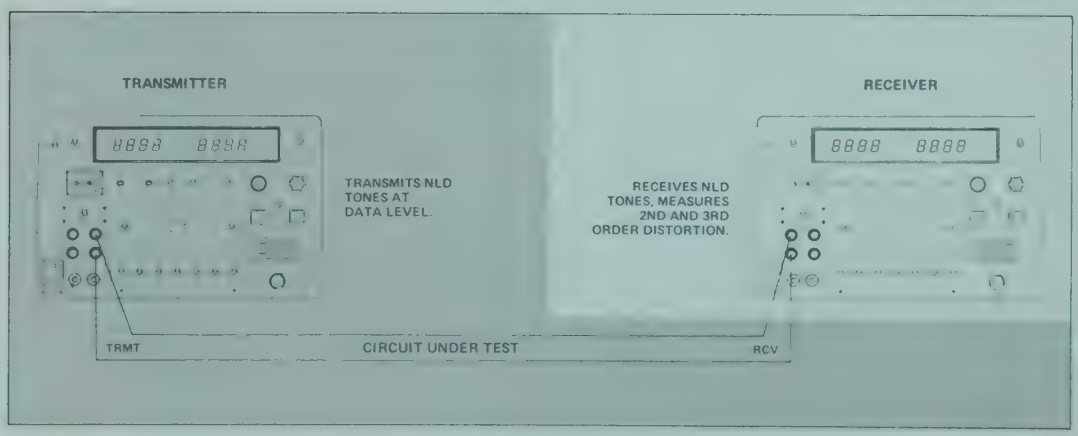
All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

5. When requested by receiver operator, momentarily hold down and release NLD CHECK Switch.

See next pages for NORMAL RECEIVER procedures.

NONLINEAR DISTORTION NORMAL RECEIVER





NONLINEAR DISTORTION NORMAL RECEIVER

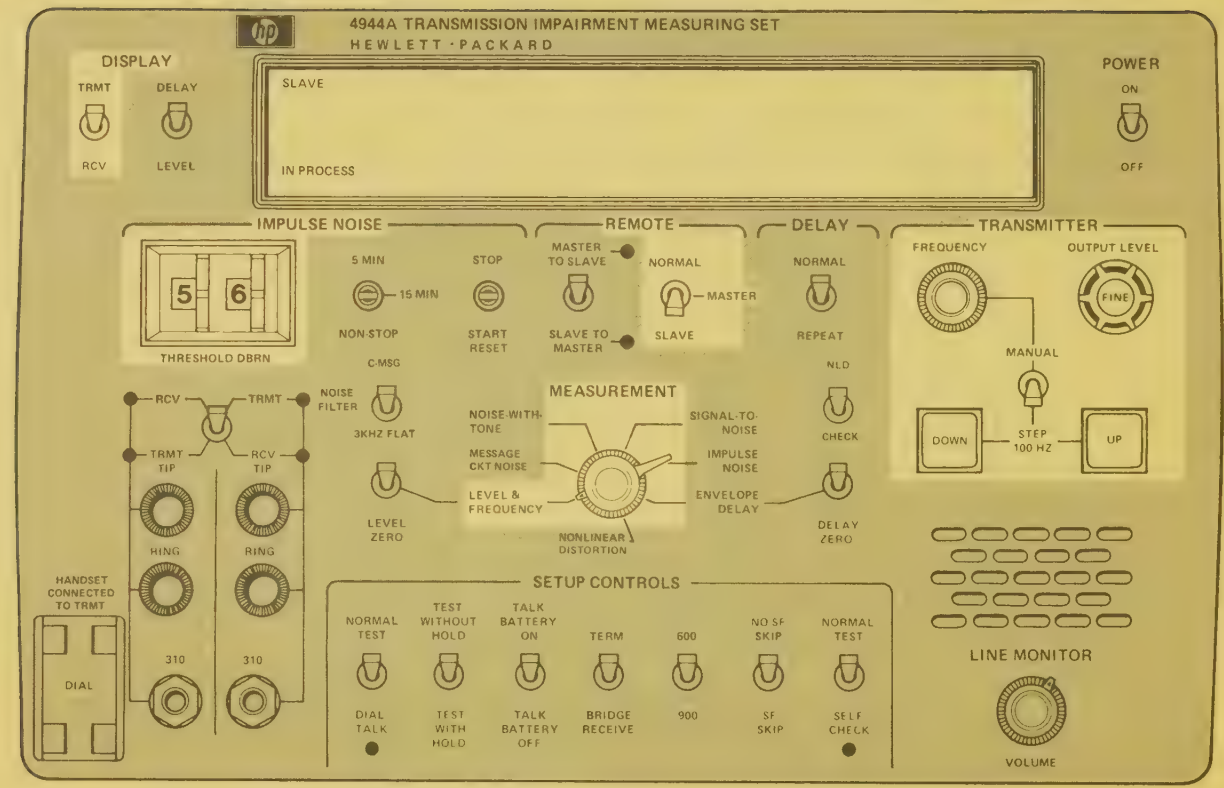
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NONLINEAR DISTORTION.
3. Set DISPLAY Switch to RCV.
4. Observe 2nd order distortion in left display. Observe 3rd order distortion in right display. This measurement has not yet been compensated for the presence of noise.
5. Instruct NORMAL TRANSMITTER Operator to depress NLD CHECK Switch.
6. Observe corrected 2nd order distortion in left display. Observe corrected 3rd order distortion in right display. After making initial noise floor measurement, readings are automatically corrected for noise, as indicated by CORRECTED annunciator. Readings are alternately updated every few seconds.

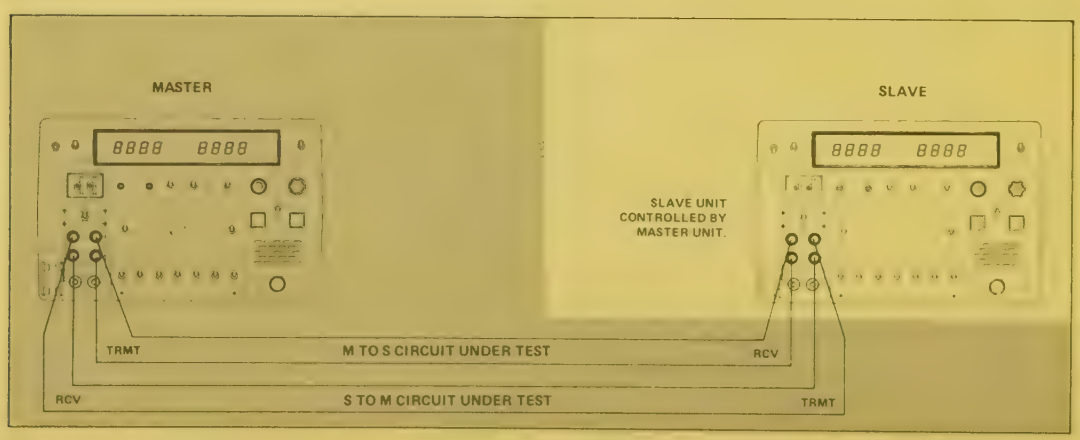
NOTE

During measurement of noise floor, the 2 and 3 displays will flash on and off. However, if displays continue flashing after CORRECTED annunciator comes on, it indicates that received signal is composed mostly of noise and not nonlinear distortion. A "–" sign after either 2 or 3 display indicates underrange (TLP – NLD = < –100 dBm).

MASTER/SLAVE OPERATION PROCEDURES

SLAVE SETUP


4944A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT · PACKARD
DISPLAY
TRMT
DELAY
RCV
LEVEL
SLAVE
IN PROCESS
POWER
ON
OFF
IMPULSE NOISE
5
6
THRESHOLD DBRN
5 MIN
15 MIN
NON-STOP
STOP
START
RESET
REMOTE
MASTER TO SLAVE
SLAVE TO MASTER
NORMAL
MASTER
SLAVE
DELAY
NORMAL
REPEAT
TRANSMITTER
FREQUENCY
OUTPUT LEVEL
FINE
MANUAL
DOWN
STEP
100 HZ
UP
C-MSG
NOISE FILTER
3KHZ FLAT
MEASUREMENT
NOISE-WITH-TONE
MESSAGE CKT NOISE
LEVEL & FREQUENCY
SIGNAL-TO-NOISE
IMPULSE NOISE
ENVELOPE DELAY
NONLINEAR DISTORTION
LEVEL ZERO
NLD
CHECK
DELAY ZERO
RCV
TRMT
TRMT TIP
RCV TIP
RING
RING
310
310
HANDSET CONNECTED TO TRMT
DIAL
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
DIAL TALK
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
SELF CHECK
LINE MONITOR
VOLUME


MASTER
SLAVE
8888 8888
8888 8888
SLAVE UNIT CONTROLLED BY MASTER UNIT.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

SLAVE SETUP

1. Perform SETUP & TURN ON procedures through Step 9.
2. Set REMOTE Switch to NORMAL.
3. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
4. Set DISPLAY Switch to TRMT.
5. Set TRANSMITTER Switch to STEP 100 HZ.
6. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL for "Data Level". Observe DBM in left display.

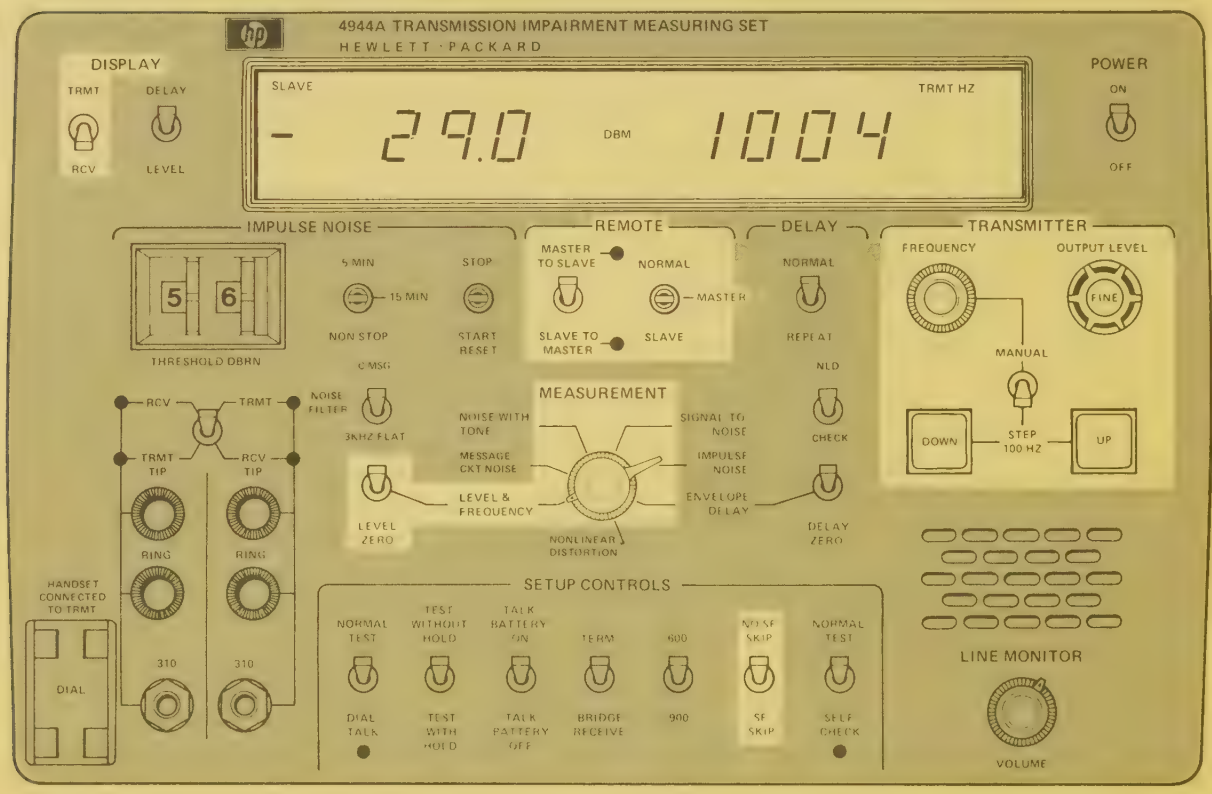
DATA LEVEL

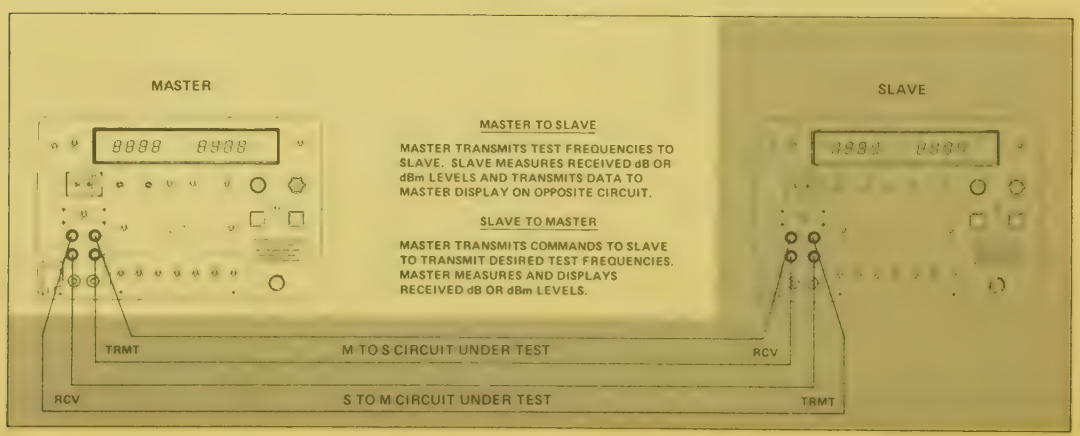
All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

8. If IMPULSE NOISE is to be measured, set IMPULSE NOISE Thumbwheel Switches to desired DBRN THRESHOLD.
9. Set REMOTE Switch to SLAVE. The SLAVE unit is now set up for control by the MASTER unit. If desired, the display annunciators can be observed to determine the progress of the MASTER unit. The following annunciators indicate the mode of the MASTER unit:

LEVEL & FREQUENCY	DBM
MESSAGE CKT NOISE	DBRN
NOISE-WITH-TONE	DBRN and TRMT HZ
SIGNAL-TO-NOISE	DB
IMPULSE NOISE	COUNTS
ENVELOPE DELAY	MICRO SEC
NON-LINEAR DISTORTION	DB and DB

LEVEL AND FREQUENCY MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS TEST FREQUENCIES TO SLAVE. SLAVE MEASURES RECEIVED dB OR dBm LEVELS AND TRANSMITS DATA TO MASTER DISPLAY ON OPPOSITE CIRCUIT.
SLAVE TO MASTER
MASTER TRANSMITS COMMANDS TO SLAVE TO TRANSMIT DESIRED TEST FREQUENCIES. MASTER MEASURES AND DISPLAYS RECEIVED dB OR dBm LEVELS.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

LEVEL AND FREQUENCY MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to TRMT.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. If SF signaling units are used in the network under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
6. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

8. Set DISPLAY Switch to RCV.
9. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

10. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.

1000 HZ LOSS MEASUREMENT

11. Observe MASTER generated TRMT HZ (nominally 1004 Hz) in right display. Observe DBM level received by SLAVE unit on left display.

ATTENUATION DISTORTION MEASUREMENT

12. Momentarily hold down LEVEL ZERO Switch. This establishes a 0 dB reference at the reference frequency (1004 Hz).
13. Transmit desired test frequencies using TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control. Observe MASTER generated TRMT HZ in right display and DB level received by SLAVE unit in left display at each test frequency. +DB indicates more loss and –DB indicates less loss, relative to the reference frequency.

SLAVE TO MASTER DIRECTION

14. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.

1000 HZ LOSS MEASUREMENT

15. Observe SLAVE generated by RCV HZ (nominally 1004 Hz) in right display. Observe DBM level received by MASTER unit in left display.

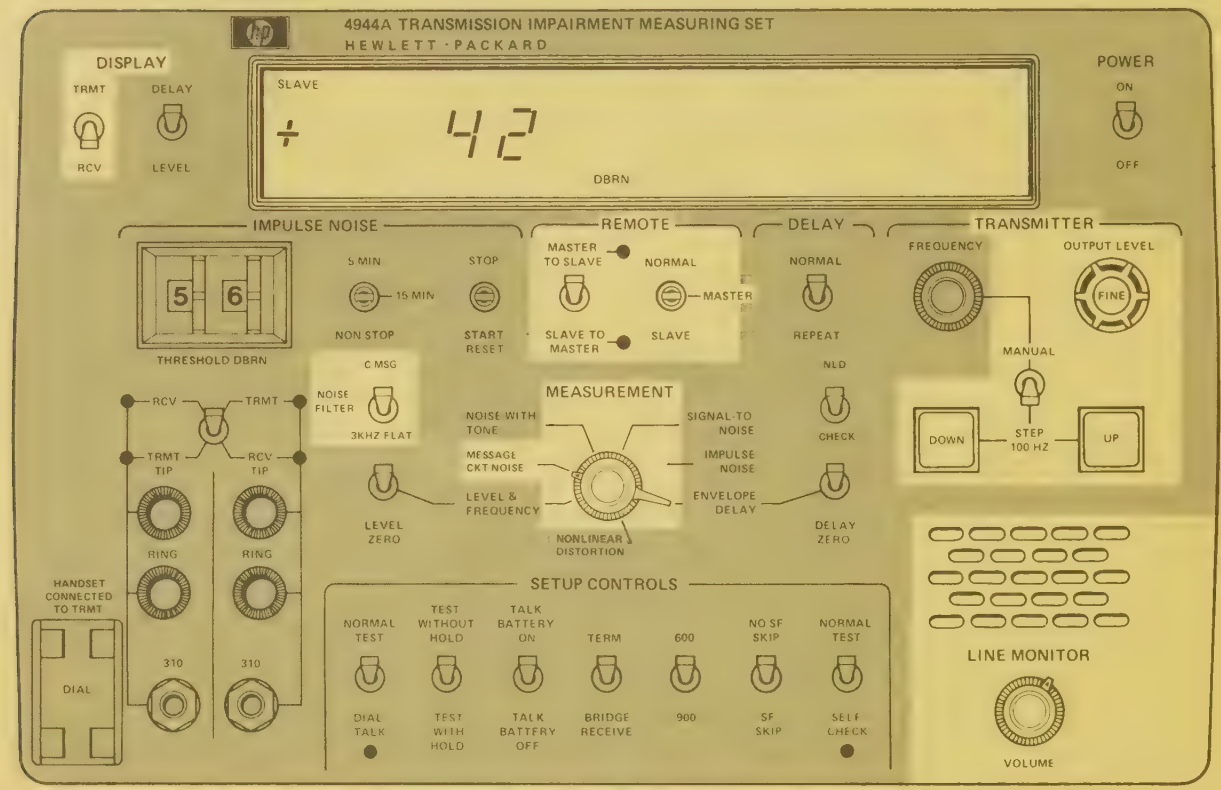
ATTENUATION DISTORTION MEASUREMENT

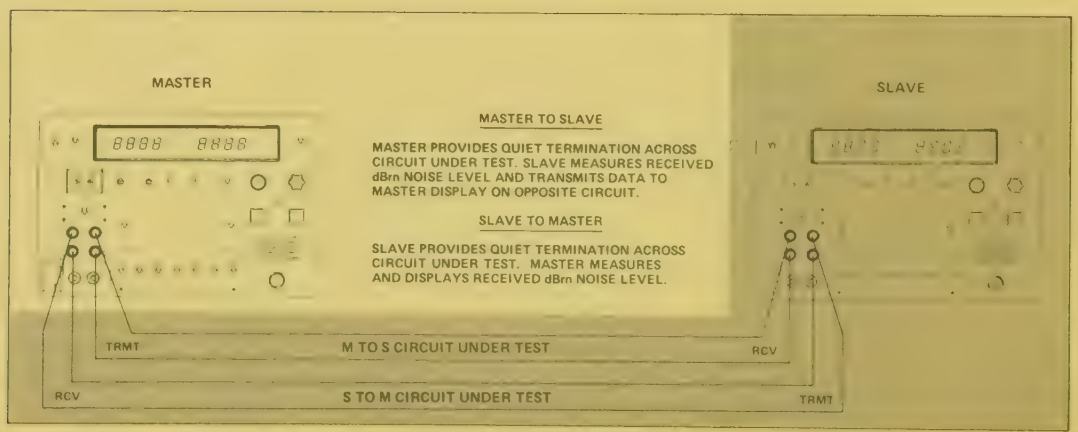
16. Momentarily hold down LEVEL ZERO Switch. This establishes a 0 dB reference at the reference frequency (1004 Hz).
17. Command SLAVE unit to transmit desired test frequencies by operating MASTER unit TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control. Observe SLAVE generated RCV HZ in right display and DB level received by MASTER unit in left display at each test frequency. +DB indicates more loss and –DB indicates less loss, relative to the reference frequency.

NOTE

Attenuation Distortion measurements can also be made in absolute dBm. The test set is automatically in the dBm mode until the LEVEL ZERO Switch is operated. To return the test set to the dBm mode, momentarily rotate MEASUREMENT Switch to another position, then back to LEVEL & FREQUENCY again.

MESSAGE CIRCUIT NOISE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER PROVIDES QUIET TERMINATION ACROSS CIRCUIT UNDER TEST. SLAVE MEASURES RECEIVED dBrn NOISE LEVEL AND TRANSMITS DATA TO MASTER DISPLAY ON OPPOSITE CIRCUIT.
SLAVE TO MASTER
SLAVE PROVIDES QUIET TERMINATION ACROSS CIRCUIT UNDER TEST. MASTER MEASURES AND DISPLAYS RECEIVED dBrn NOISE LEVEL.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

MESSAGE CIRCUIT NOISE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to TRMT.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set MEASUREMENT Switch to MESSAGE CKT NOISE.
8. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
9. Set DISPLAY Switch to RCV.
10. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

11. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
12. Observe DBRN noise level received by SLAVE unit in left display. NOTE: "H-10" in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

13. In order to perform a Single Frequency Interference Check in the Master to Slave Direction, the SLAVE unit must turn on his LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. He should listen for any predominant tone which will indicate a potential single frequency interference problem.

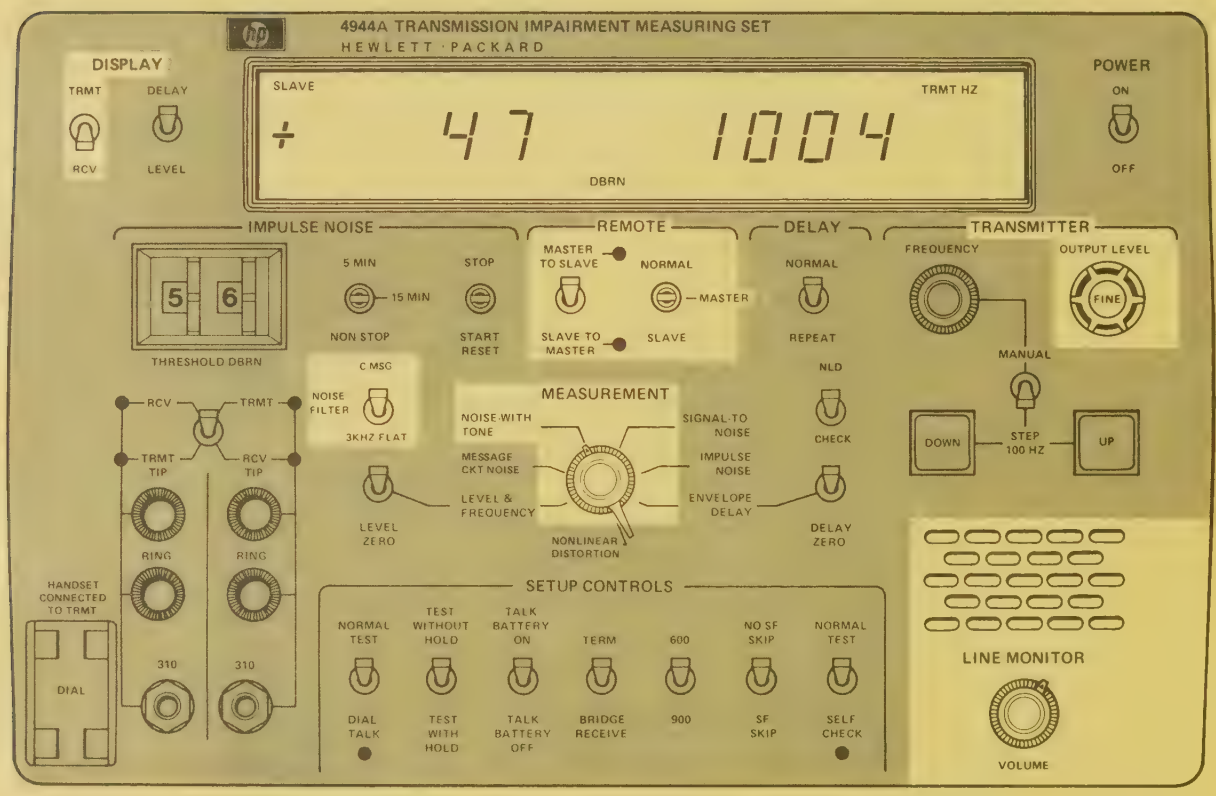
SLAVE TO MASTER DIRECTION

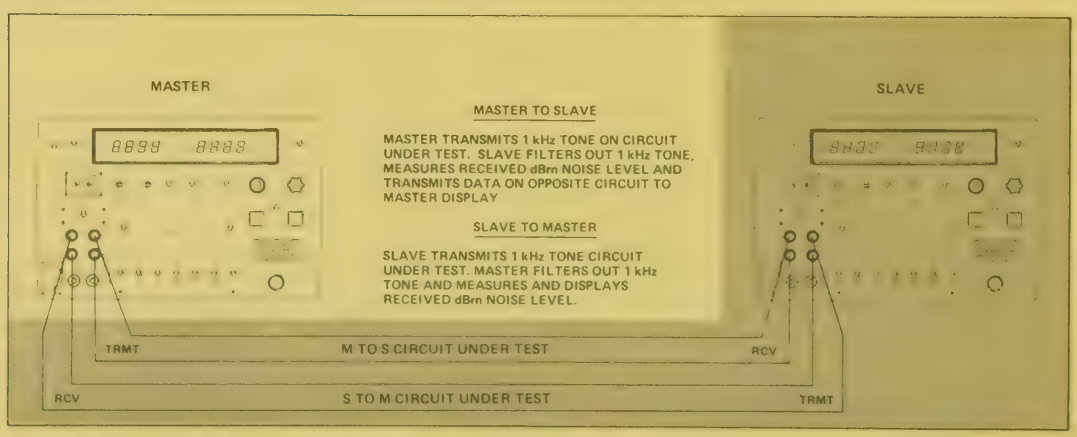
14. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
15. Observe DBRN noise level received by MASTER unit in left display. NOTE: A "− " sign in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

16. Turn on LINE MONITOR by adjusting VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

NOISE-WITH-TONE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE FILTERS OUT 1 kHz TONE, MEASURES RECEIVED dBrn NOISE LEVEL AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE CIRCUIT UNDER TEST. MASTER FILTERS OUT 1 kHz TONE AND MEASURES AND DISPLAYS RECEIVED dBrn NOISE LEVEL.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

NOISE-WITH-TONE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NOISE-WITH-TONE.
3. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
4. Set DISPLAY Switch to TRMT.
5. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data LEVEL. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

7. Set DISPLAY Switch to RCV.
8. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

9. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
10. Observe MASTER generated TRMT HZ (1004 Hz) in right display. Observe DBRN noise level received by SLAVE unit in left display. NOTE: "H-10" in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

11. In order to perform a Single Frequency Interference Check in the Master to Slave Direction, the SLAVE unit must turn on his LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. He should listen for any predominant tone which will indicate a potential single frequency interference problem.

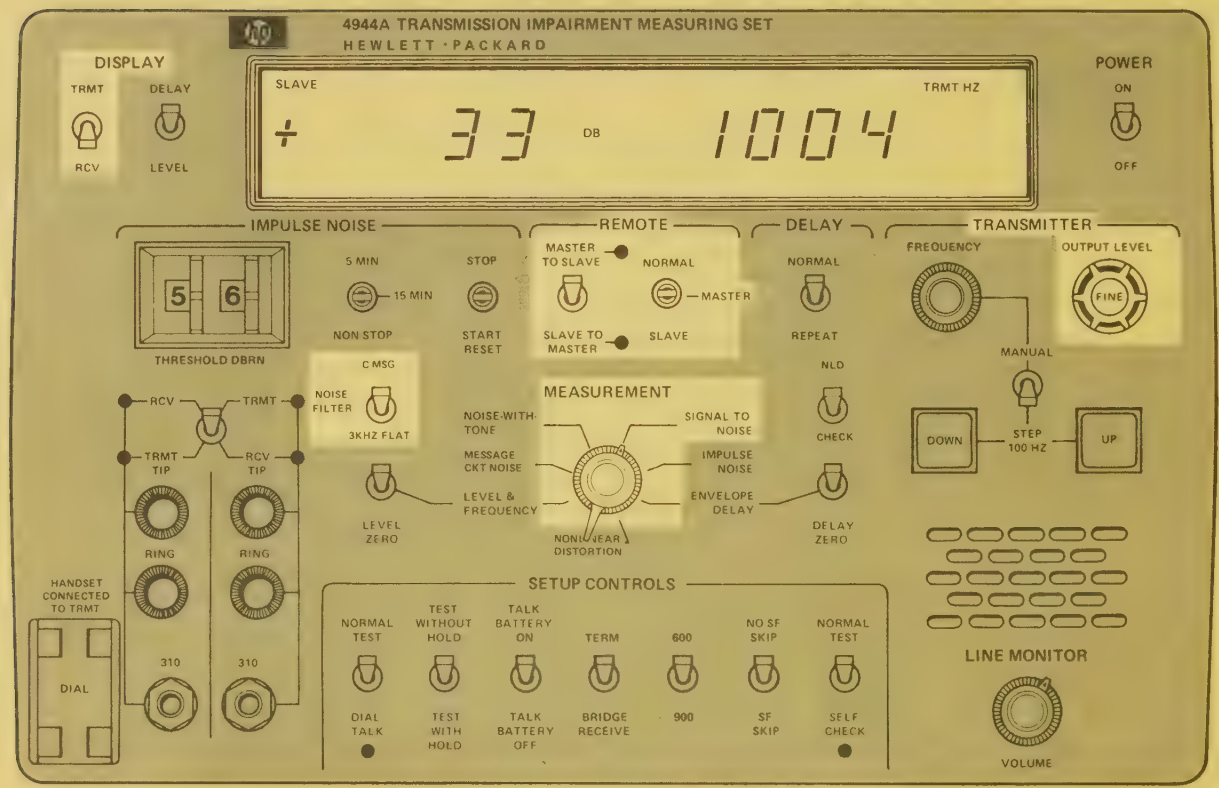
SLAVE TO MASTER DIRECTION

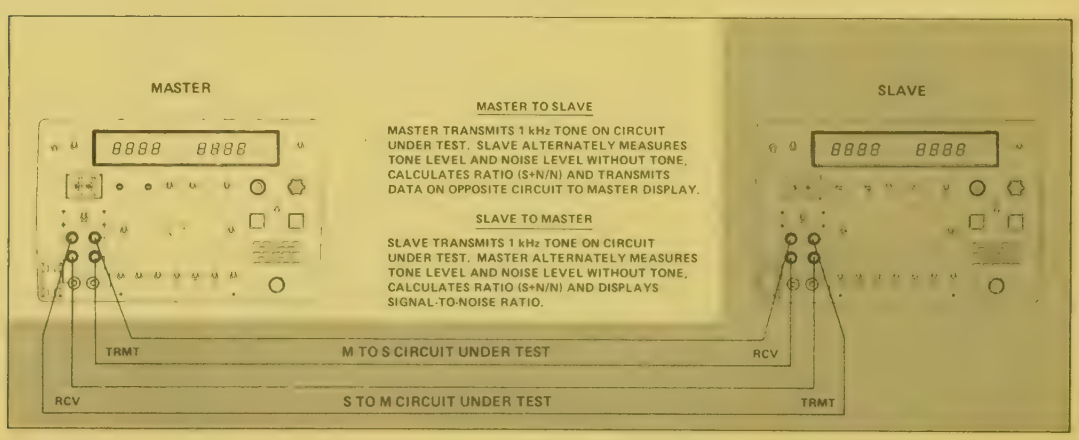
12. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
13. Observe SLAVE generated RCV HZ (1004 Hz) in right display. Observe DBRN noise level received by MASTER unit in left display. NOTE: A "–" sign in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

14. Turn on LINE MONITOR by adjusting VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

SIGNAL-TO-NOISE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE ALTERNATELY MEASURES TONE LEVEL AND NOISE LEVEL WITHOUT TONE, CALCULATES RATIO (S+N/N) AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY.
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. MASTER ALTERNATELY MEASURES TONE LEVEL AND NOISE LEVEL WITHOUT TONE, CALCULATES RATIO (S+N/N) AND DISPLAYS SIGNAL-TO-NOISE RATIO.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

SIGNAL-TO-NOISE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to SIGNAL-TO-NOISE.
3. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
4. Set DISPLAY Switch to TRMT.
5. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

7. Set DISPLAY Switch to RCV.
8. Set REMOTE Switch to MASTER.

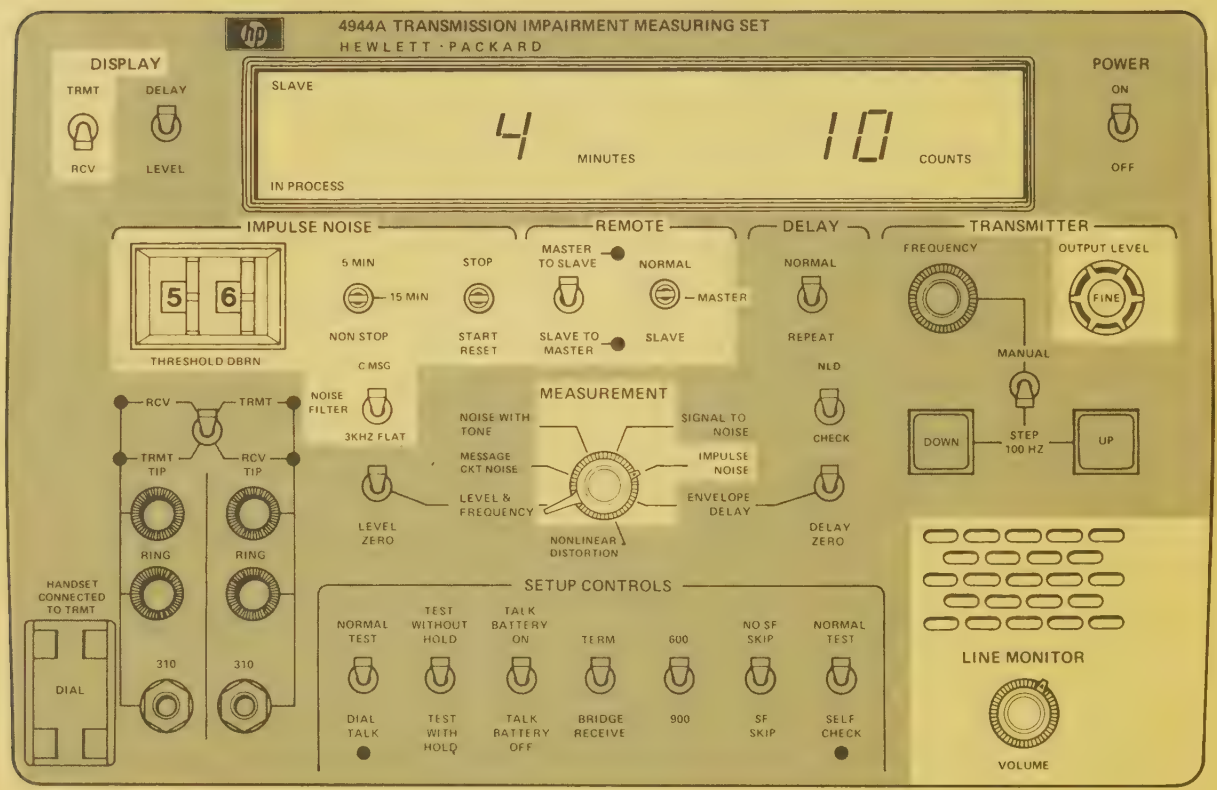
MASTER TO SLAVE DIRECTION

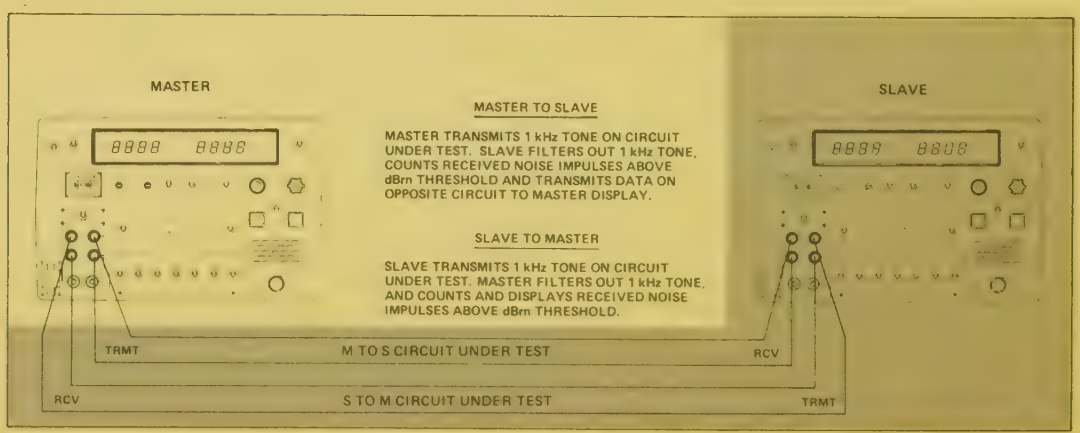
9. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
10. Observe MASTER generated TRMT HZ (1004 Hz) in right display. Observe DB signal-to-noise ratio (S+N/N) received by SLAVE unit in left display. NOTE: "H-10" in left display indicates underrange (noise <20 DBRN).

SLAVE TO MASTER DIRECTION

11. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
12. Observe SLAVE generated RCV HZ (1004 Hz) in right display. Observe DB signal-to-noise ratio (S+N/N) received by MASTER unit in left display. NOTE: A "–" sign in left display indicates underrange (noise <20 DBRN).

IMPULSE NOISE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE FILTERS OUT 1 kHz TONE, COUNTS RECEIVED NOISE IMPULSES ABOVE dBrn THRESHOLD AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY.
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. MASTER FILTERS OUT 1 kHz TONE, AND COUNTS AND DISPLAYS RECEIVED NOISE IMPULSES ABOVE dBrn THRESHOLD.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

IMPULSE NOISE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to IMPULSE NOISE.
3. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
4. Set DISPLAY Switch to TRMT.
5. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is – 16 dB, the Data Level would be – 29 dBm. Therefore, an output level of – 29 dBm would be applied in this case.

7. Set DISPLAY Switch to RCV.
8. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

9. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
10. Set IMPULSE NOISE Switch to desired count interval (5 MIN, 15 MIN, or NON-STOP).
11. Verify that SLAVE unit IMPULSE NOISE Thumbwheel Switches have been set up to desired DBRN THRESHOLD. (This should have been performed during his SLAVE SETUP procedure).
12. Momentarily hold down and release IMPULSE NOISE STOP-START/RESET Switch to START/RESET position. Observe that IN PROCESS Annunciator comes on.
13. Left display indicates count time (in minutes) remaining in 5 MIN and 15 MIN modes. Elapsed time is indicated for NON-STOP mode.
14. Observe that IN PROCESS Annunciator goes out at completion of 5 MIN or 15 MIN interval. Observe impulse noise COUNTS received by SLAVE unit on right display.
15. If NON-STOP mode is used, momentarily hold up and release IMPULSE NOISE STOP-START/RESET Switch to STOP position at end of desired counting interval. Observe impulse noise COUNTS received by SLAVE unit in right display.

SINGLE FREQUENCY INTERFERENCE CHECK

16. In order to perform a Single Frequency Interference Check in the Master to Slave Direction, the SLAVE unit must turn on his LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. He should listen for any predominant tone which will indicate a potential single frequency interference problem.

(continued on next page)

17. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
18. Set IMPULSE NOISE Switch to desired count interval (5 MIN, 15 MIN, or NON-STOP).
19. Set IMPULSE NOISE Thumbwheel Switches to desired DBRN THRESHOLD.
20. Momentarily hold down and release IMPULSE NOISE STOP-START/RESET Switch to START/RESET position. Observe that IN PROCESS Annunciator comes on.
21. Left display indicates count time (in minutes) remaining in 5 MIN and 15 MIN modes. Elapsed time is indicated for NON-STOP mode.
22. Observe that IN PROCESS Annunciator goes out at completion of 5 MIN or 15 MIN interval. Observe impulse noise COUNTS received by MASTER unit in right display.
23. If NON-STOP mode is used, momentarily hold up and release IMPULSE NOISE STOP-START/RESET Switch to STOP position at end of desired counting interval. Observe impulse noise COUNTS received by MASTER unit in right display.

SINGLE FREQUENCY INTERFERENCE CHECK

24. Turn on LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

NOTE

Count can be reset to zero and restarted at any time by momentarily holding switch to START/RESET position. Count can also be stopped at any time by momentarily holding switch to STOP position, however, count must be restarted at zero counts.

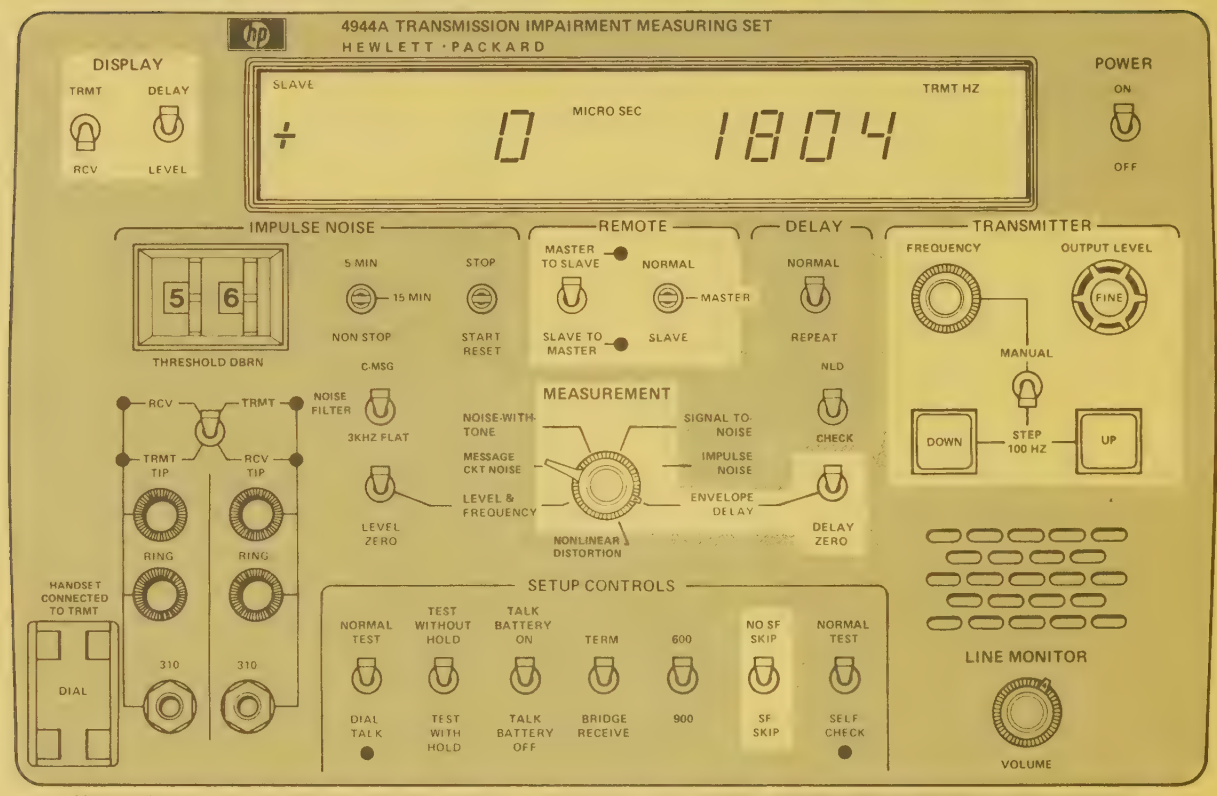
NOTE

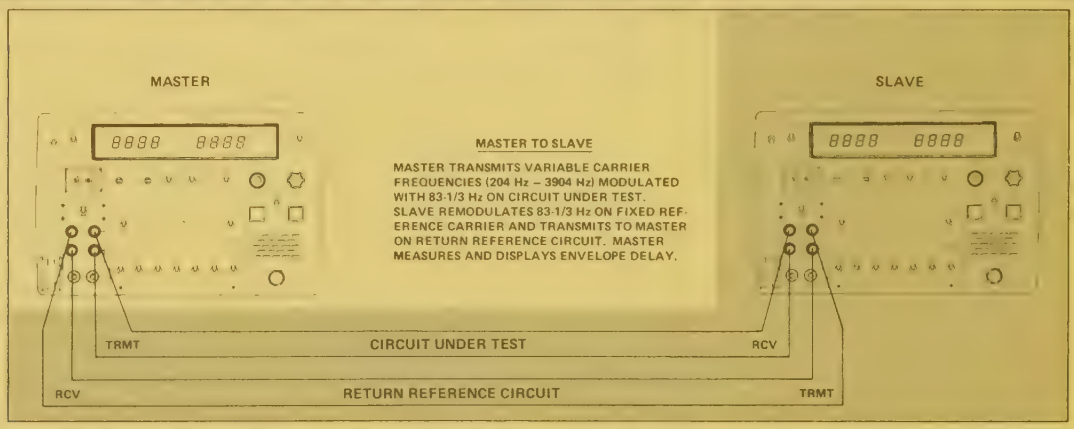
The right display has a maximum capacity of 9999 COUNTS. If this capacity is exceeded, the display will indicate "H-12" to indicate "accumulator overflow condition".

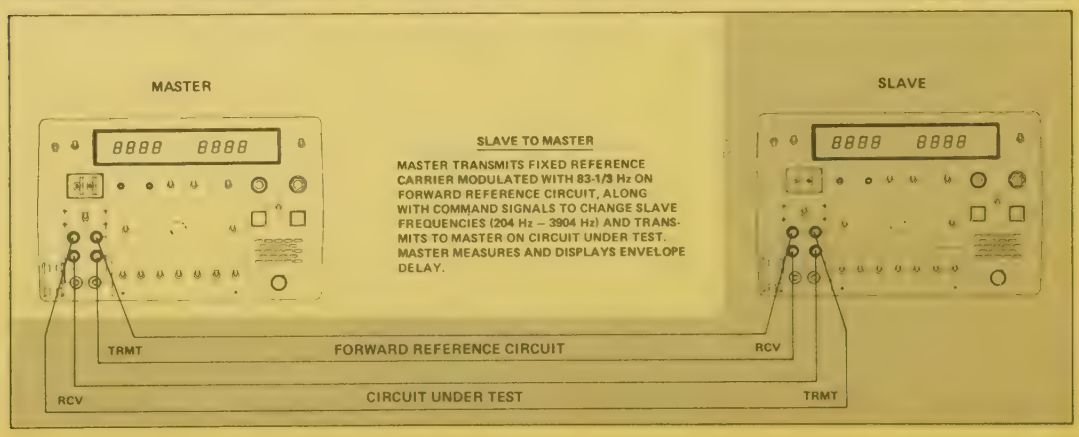
NOTE

If a circuit drop-out exceeding one second occurs at any time during the counting interval, a condition code "H-14" will be displayed. If this occurs, it will be necessary to re-establish control over the SLAVE unit by momentarily throwing the REMOTE Switch to NORMAL, then back to MASTER again.

ENVELOPE DELAY MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS VARIABLE CARRIER FREQUENCIES (204 Hz – 3904 Hz) MODULATED WITH 83-1/3 Hz ON CIRCUIT UNDER TEST. SLAVE REMODULATES 83-1/3 Hz ON FIXED REFERENCE CARRIER AND TRANSMITS TO MASTER ON RETURN REFERENCE CIRCUIT. MASTER MEASURES AND DISPLAYS ENVELOPE DELAY.
TRMT
CIRCUIT UNDER TEST
RCV
RCV
RETURN REFERENCE CIRCUIT
TRMT


MASTER
SLAVE
SLAVE TO MASTER
MASTER TRANSMITS FIXED REFERENCE CARRIER MODULATED WITH 83-1/3 Hz ON FORWARD REFERENCE CIRCUIT, ALONG WITH COMMAND SIGNALS TO CHANGE SLAVE FREQUENCIES (204 Hz – 3904 Hz) AND TRANSMITS TO MASTER ON CIRCUIT UNDER TEST. MASTER MEASURES AND DISPLAYS ENVELOPE DELAY.
TRMT
FORWARD REFERENCE CIRCUIT
RCV
RCV
CIRCUIT UNDER TEST
TRMT

ENVELOPE DELAY MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to ENVELOPE DELAY.
3. Set DISPLAY Switches to TRMT and LEVEL.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. If SF signaling units are used in the network under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
6. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

8. Set DISPLAY Switch to RCV.
9. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION (RETURN REFERENCE)

10. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
11. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

NOTE

This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

12. Observe MASTER generated TRMT HZ in right display. Select desired test frequencies using TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control.
13. At each test frequency, observe ± MICRO SEC envelope delay received by SLAVE unit in left display. If readings vary, observe for an arithmetic mean (average).

SLAVE TO MASTER DIRECTION (FORWARD REFERENCE)

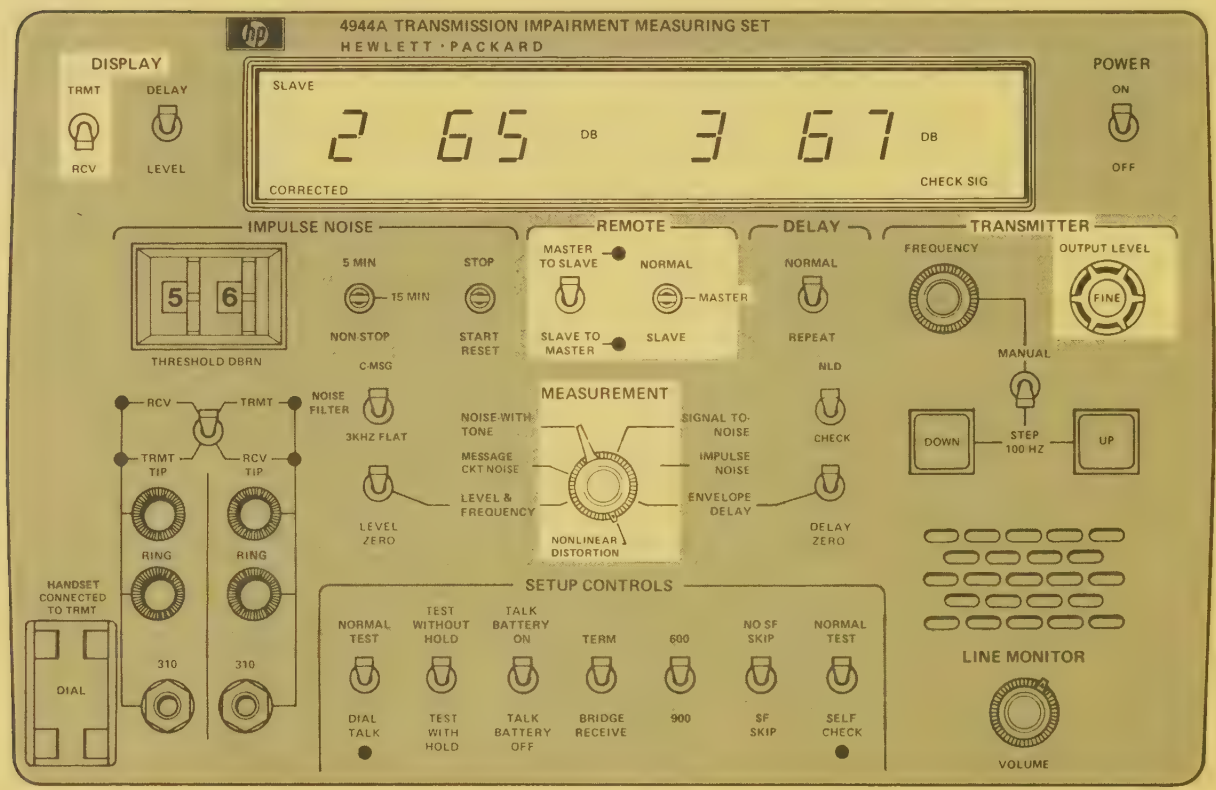
14. Perform MASTER SETUP steps 1-9.
15. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
16. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

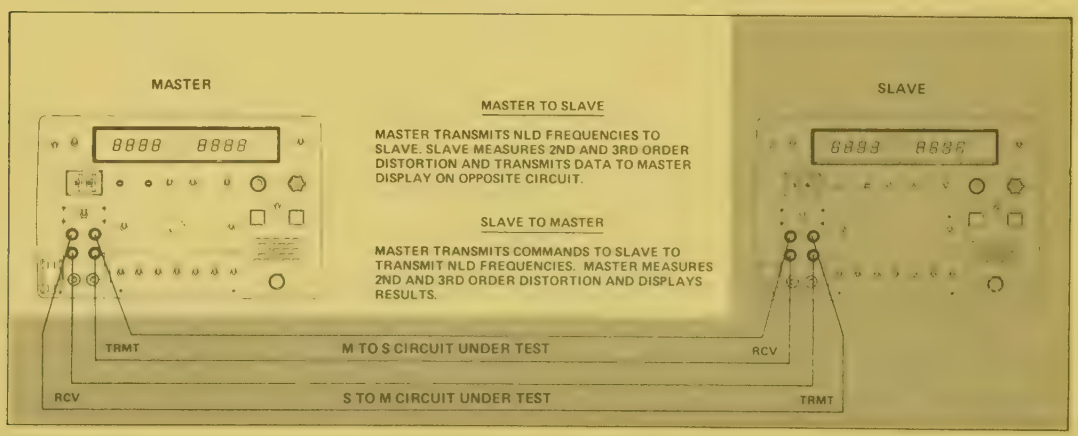
NOTE

This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

17. Observe SLAVE generated RCV HZ in right display. Command SLAVE unit to transmit desired test frequencies by operating MASTER unit TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control.
18. At each test frequency, observe ±MICRO SEC envelope delay received by MASTER unit in left display. If readings vary, observe for an arithmetic mean (average).

NONLINEAR DISTORTION MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS NLD FREQUENCIES TO SLAVE. SLAVE MEASURES 2ND AND 3RD ORDER DISTORTION AND TRANSMITS DATA TO MASTER DISPLAY ON OPPOSITE CIRCUIT.
SLAVE TO MASTER
MASTER TRANSMITS COMMANDS TO SLAVE TO TRANSMIT NLD FREQUENCIES. MASTER MEASURES 2ND AND 3RD ORDER DISTORTION AND DISPLAYS RESULTS.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

NONLINEAR DISTORTION MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NONLINEAR DISTORTION.
3. Set DISPLAY Switch to TRMT.
4. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

5. Set DISPLAY Switch to RCV.
6. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

7. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
8. Observe 2nd order distortion measured by SLAVE unit in left display. Observe 3rd order distortion measured by SLAVE unit in right display. After making initial noise floor measurement, readings are automatically corrected for noise, as indicated by CORRECTED annunciator. Readings are alternately updated every few seconds.

NOTE

During measurement of noise floor, the 2 and 3 displays will flash on and off. However, if displays continue flashing after CORRECTED annunciator comes on, it indicates that received signal is composed mostly of noise and not nonlinear distortion. A "−" sign after either 2 or 3 display indicates underrange (TLP − NLD = $<$100 dBm).

SLAVE TO MASTER DIRECTION

9. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
10. Observe 2nd order distortion measured by MASTER unit in left display. Observe 3rd order distortion measured by MASTER unit in right display. After making initial noise floor measurement, readings are automatically corrected for noise, as indicated by CORRECTED annunciator. Readings are alternately updated every few seconds.

NOTE

During measurement of noise floor, the 2 and 3 displays will flash on and off. However, if displays continue flashing after CORRECTED annunciator comes on, it indicates that received signal is composed mostly of noise and not nonlinear distortion. A "−" sign after either 2 or 3 display indicates underrange (TLP − NLD = $<$100 dBm).

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